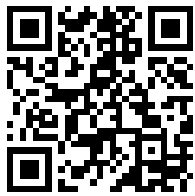

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CONTENTS.

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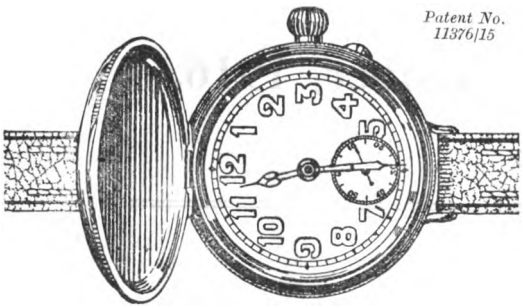

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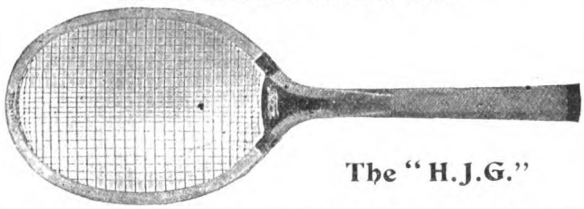

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RANGING FROM AN OBSERVATION POST TO A FLANK.

BY ANON.

[NOTE.—The author has requested publication to be made of the following revised version of the article under the above heading, published in the R.A. "Journal" of July 1916, to bring it up to date].

RANGING a Battery on a narrow target from an O.P. to a flank has from the beginning of the war been regarded by many B.C.'s as one of the most difficult operations they are called upon to carry out.

There is no doubt but that on many occasions far more ammunition is expended than necessary on this type of shoot, and it is to be feared that sometimes it is expended without result, owing to the B.C. having no system.

Various efforts have been made and schemes put forward, and possibly the solution of the problem has not yet been satisfactorily found by all, as most B.C's adopt any expedient rather than range a battery from an O.P. to a flank. One desperate scheme put forward was an instrument, for mechanically finding the correction for each round, quite ingenious in its way, but based on the assumption that it was possible for the B.C. to judge the amount in yards the shot fell over or short of the target along his line of observation. This of course, is not possible.

Then again, many officers often grasp the theory quite easily but will yet fail, when applying it practically. The following notes are written to show how simple the operation really is.

The situation when the B.C. is close up, and has a good view of the ground round the target, or has a broad easy target on which to range, is excluded. In these cases he should be able to keep before him a mental picture of the two lines O.T. & B.T., or draw a rough picture of these two lines and range on the line B.T. as usual.

In the following description, this is assumed not to be the case.

Let us first consider the simple case when the B.C. is in the line B.T. His procedure is, first to correct his line, which he does by observing how much a shot falls Right or Left, and altering his deflection accordingly. This will take one or two rounds.

Once the line is correct all future shots should fall line or nearly so, owing to the generally small 50% breadth zone.

Having obtained the correct line, the B.C. ranges for elevation.

He does this by observing if the target shows up against the shell burst when the shell is + or is blotted out by it, when it is −, and he brackets accordingly. When he has got his M.P.I. on the target, a certain proportion of rounds will hit the target, depending on the size of the target, and the 50% length zone, *and the remainder will fall over or short.*

Now if the B.C. is to a flank, he proceeds on exactly the same principles, but he must range along O T instead of B T, and he should now think of + and −, and R and L, as referring to O T, and not B T.

Now, the main principles are exactly the same as in the simple case where the observer is in the line B.T. The B.C. must first get a round on to his line, and afterwards he must range up and down his line. The procedure however differs slightly. In Fig. 1, if a shot falls at S the observer at O cannot tell if the shot is + or − ; all that he can tell is that it is to the right of the line O T. He can bring it on to his line O T, by decreasing the elevation and bringing the shot to S_1, or by giving left deflection, and bringing it to S_2.

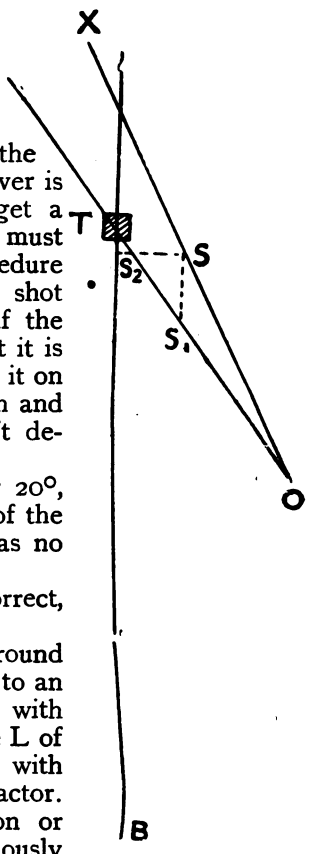


Fig. 1.

Except with small apex angles under 20°, it is better to get on the L of O by means of the elevation factor, provided that the B.C. has no reason to doubt his line being correct.

It will be seen that if the line is quite correct, the 2nd round will probably be a hit.

If the B.C. considers that the first round falling wide is equally likely to be due to an error in line as an error in range, then with angles under 45° it is better to get on to the L of O by means of the deflection factor, and with angles over 45° by means of the elevation factor.

To ascertain the amount of elevation or deflection to give, a simple factor, previously ascertained, is applied to the observation. (This factor can be taken out of a table of angles, or found by an exceedingly simple calculation in a couple of minutes. See page 177). Thus, presume the factor for elevation is ⅓ and that for deflection is ⅔ and the B.C. observes the fall of the first round as 3° R.

He can either come down ⅓ of 3° = 1°, in elevation, and bring the shot to S.1, or give ⅔ of 3° = 2° M.L. deflection, and bring it to S.2. His next round should fall on his line O.T. and can be observed as −. The B.C. now proceeds to try and get a round the other side of the target or + along O T, in order to get a bracket.

It will be seen in Fig. 2, that if the B.C. gives only elevation, the shot will fall at say Y, whereas if he gives only deflection, it will fall at Z, and that to bring it to S_3, he must give both elevation and deflection.

To ascertain how much deflection to give where the elevation is altered, again a simple factor (obtained as before) is used. It is generally known as the combined factor. Presume this to be ½ and the B.C. goes up 80 minutes, then he must also give 40 minutes more left.

This factor must always be used to find what deflection is re-

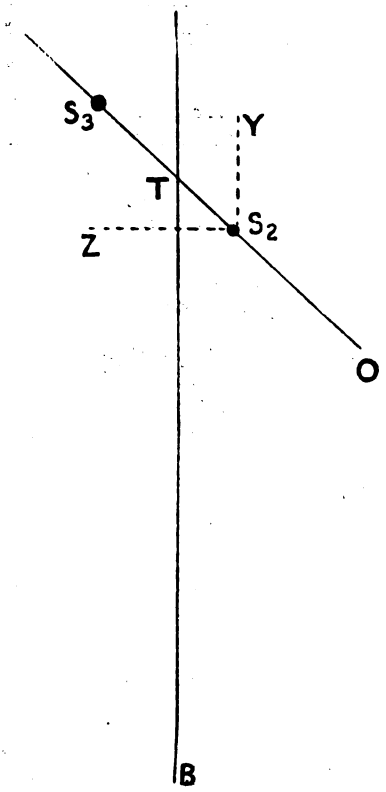


FIG. 2.

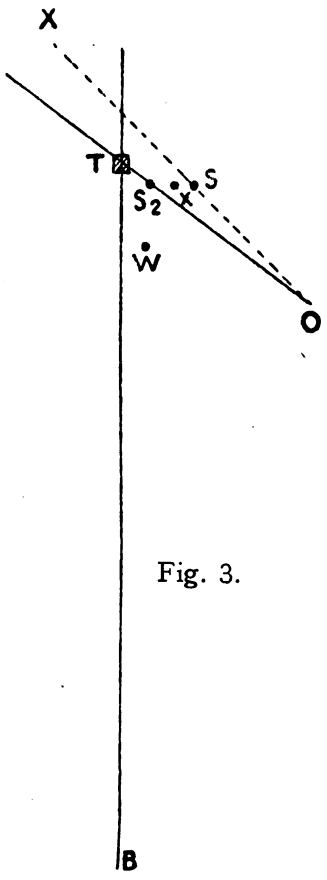


Fig. 3.

quired at each change of elevation. Using this factor the B.C. continues bracketting until the target is found.

If however the B.C. decides to bracket with deflection, then he makes a bracket of 20, 40, or 80 minutes deflection and at the same time gives the necessary alteration of elevation to keep the shot on his L of O. This alteration of elevation is found by using the same combined factor as before, viz: $\frac{D}{E}$ but in this case inverting it and using it as $\frac{E}{D}$

Thus presume $\frac{D}{E} = 4$. Then if he gives 40′ M L he must also give $\frac{1}{4} \times 40 = 10'$ more elevation. He then keeps splitting his deflection bracket until he has narrowed it down to 5′, and obtained his battery line, by which time the correct elevation will also have been found. With howitzers it is simpler to bracket with deflection if the combined factor is over 1.

The B.C. when doing so judges a round as + and − from O according as to whether the shot is the far or near side of the line B T. It will be noted that the most favourable wind for so judging is up or down B T.

Theoretically the above system is absolutely correct, and the B.C. should not require a single round more with which to range than if he was on the line B.T.

Many officers grasp the theory, and then fail practically.

The rock on which they founder is the length zone.

What happens is this. When a B.C. is in the line B.T., the effect of the length zone is not generally seen; he simply judges a round as + or −, and following the bracket system, eventually finds the target.

Once however B.C's begin to get round to a flank, they *see* the effect of the 50% length zone, and the further they get round, the more do they see it. In fact it causes a percentage only of the shot to fall on the line O.T., even after the B.C. has made the necessary corrections, *the remainder of the rounds falling Right or Left*, in exactly the same way as when the B.C. has his M.P.I. on the target a percentage of shell will hit it and *the remainder will fall + or −*, and a B.C. who has not studied the effect of the zones gets rattled, thinks his factors are wrong, throws over the system and perhaps fails to find the target, when all that has been happening is that the length zone has been acting in the normal way.

If he will only realize this, it is all perfectly simple. All he has to do is to repeat any round which does'nt fall on or sufficiently near his line, to enable him to judge it as + or −. Take Fig. 1 again. The B.C. observes his first shot which falls at S as 3° R. He orders 2° M.L. His next round should fall at S_2, but the length zone comes into play, the gun shoots short and the shell falls at W, and is observed say 2° Left. Presume the B.C. has not studied his length zone; he corrects on round 2 and gives ⅔ of 2° = 1° 20′ M.R. This time the gun shoots up again, shot falls at X, say 1° 30′ R. The B.C. is now in despair. He has made two attempts to get on to his line and failed. *If he had repeated round 2, it would have fallen on his line at S.2.*

The whole secret is to repeat.

When after making the necessary calculation the next shot does not fall on the line O.T., that round should be repeated. The length zone will probably bring the next round on for line.

Of course it may happen that the first round is the irregular one. Then on repeating the second round, the third will probably fall near the 2nd, thus showing the first one was unreliable. In this case a correction on rounds 2 and 3 should be made after round 3.

The above is the system taught for Ranging heavy howitzers and guns on a narrow target from a position on a flank. The principles apply equally well to Field and Heavy Artillery if called upon to engage a similar target.

With difficult targets, it is advisable to use "single gun ranging". With very narrow targets, or very big 50% zones it may be necessary

to repeat 2 or 3 times before making an alteration. The motto of the B.C. ranging along the line of observation is "Repeat."

To find the Factors.

Presume O.T. = 1300 yards.
B.T. = 8000 „
B.T.O. = 35° „
9·2″ Howitzer: charge 10lbs. 4 ozs.

By Tables.

Look up page headed 35°.
Opposite 1300, under O read 143′ (O)
Opposite 8000, under B read 29′ (B)

Look up page headed 9·2″ Howitzer: column 10lbs. 4 ozs.
Opposite 8000 read 27′ (E)

Factor $\frac{E}{O} = \frac{27}{143} = \frac{1}{5}$ (near enough).

„ $\frac{D}{O} = \frac{29}{143} = \frac{1}{5}$

„ $\frac{D}{E} = \frac{29}{27} = 1$

By Calculations.

Presume the range increased or decreased by 100 yards.

It is required to find:—

(1). Minutes observation at O corresponding to this 100 yds.
(2). Minutes deflection at B to bring a round 100 on B.T. to O.T.
(3). Minutes of gun elevation corresponding to 100 yds.

For (1) Set 35° under 1300 and under 100 read 152′ (O)
For (2) Set 35° under 100 and over 35 read 70 yds = 210 ft.

By 1146 rule, deflection = 30′ (D).

For (3) See R.T. = 27′ (E).

The factors will be the same as by Tables above.

If ranging in yards, the factors are simplified as E is always 100.

The figures found by calculation differ slightly from those given by the tables. The latter were made out for an increase of 100 yds. along B.T. and not 100. The practical difference however is nil, and the tables may be taken as accurate.

NOTE.—The 2nd edition of the tables is quite accurate, as they are made out for ± 100.

THE CAMPAIGN OF 1914 IN FRANCE.

By Champaubert.

Translated from the French by Major H. T. Hawkins, R.G.A. with the kind permission of Messrs. Berger-Levrault, and "Le Journal l'Illustration," Paris.

I venture to think that this short and clear account of a campaign which has already become history will be of interest to the military student. It shows, in a form easily committed to memory, the principal strategic events in a struggle in which the elasticity of the French training thoroughly vindicated the work of their General Staff in peace, by triumphing over the well thought out scheme of the German attack carried out as was possible to their admirably drilled forces alone in Europe. The author pays in restrained language a well deserved tribute to General Joffre. It would be difficult to speak too highly of the conduct of this truly great man, who, with the fate of civilisation trembling in the balance, had the strength of mind to give up a large expanse of his country to the enemy, and impose on his men the hardships, moral and physical, of a long retreat, in order to re-establish the strategical situation. How many of us must admit, as the translator does frankly, to what an extent the long months of anxiety, during which our forces were getting ready to strike, were made endurable by reliance on his proved judgment and energy.—*H.T.H.*

Strategic doctrine in France and Germany.

After the sad experiences of 1870 wounded France had at first no other thought but to protect herself from another invasion: she wanted to safeguard her frontier by a barrier of fortresses. General Séré de Rivière arranged for the construction of the fortified systems of the Meuse (Verdun—Toul) and the Moselle ((Epinal—Bélfort) which only left open two narrow gaps between Luxembourg and Switzerland.

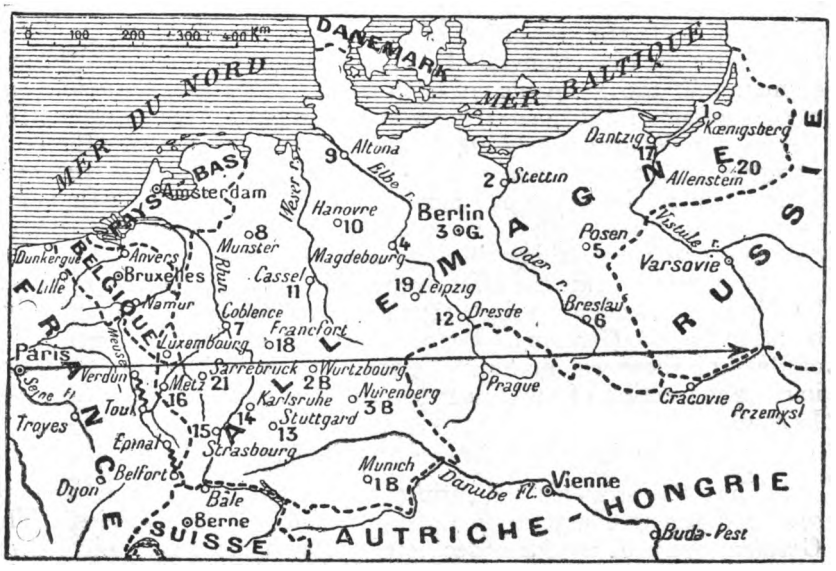
At this epoch Moltke ruled as an absolute master over the German army. The veteran marshal had always expressed a great contempt for fortifications and entrenched camps, "the history of which," he would say, "is mixed up with that of capitulations." He attached importance only to the rapidity of concentration of armies on the frontier, and for that reason he busied himself only, towards the end of his life, in developing and perfecting the network of railways which lead into Alsace—Lorraine.

The death of Moltke preceded by a few months only the conclusion of the Franco-Russian alliance which presented to the General Staff of Berlin a delicate problem. The position of Germany between her two neighbours East and West was very dangerous. However the mobilisation of the Russian army, badly served as it was by insufficient communications, must be slow, and its concentration slower still. Germany could then employ a method which had often succeeded with Napoleon, by acting at first with the mass of her

forces against France and endeavouring to put her out of the running as soon as possible, and then returning to her Eastern frontier; it was necessary for success that the offensive should be briskly led and carried through without a stop to a decisive finish. But from the first step on our territory the German columns would dash themselves aginst our fortified barriers, too strong to be carried by assault, and difficult to turn by the narrow channels that General de Rivière had left clear of works. Only a wide sweeping movement through neutral countries enabled them to be avoided.

The existence of these troublesome barriers was not the only obstacle to the rapidity of a German attack. The want of space to bring into line her immense effectives equally fettered it. Already in 1870 the frontier from the Rhine to the Moselle scarcely sufficed for the strategic development of her sixteen army corps. While approaching the Sarre the army of Steinmetz encroached on the line of march of that of Prince Frédéric Charles, who went so far as to direct one of his divisions to clear, by force if necessary, the roads allotted to it. Since then the number of army corps had considerably increased and the treaty of Frankfort had reduced the frontier to about 50 kilometres—on a front so exiguous the invaders would have been obliged to echelon in depth, reducing the war to a huge combat of attrition, very unsuitable for arriving at an early decision.

These considerations militated in favour of an offensive through Belgium and Luxembourg. It sufficed for the rest to glance at the map to determine that the natural way of access for the greater part



——➤ Line from Paris to a point North of the French and German frontier prolonged to Germany.
1 to 21 Prussian, Saxon &c., Corps.
I B to 3 B Bavarian Corps.
G Prussian Guard.
~~~~ Fortified French area.
~~~~

of the German army passes through this region. The territories from which eight corps of the German army are drawn are on a level with our frontier, the seventeen others extend more to the north, and for each the shortest route from its chief town to Paris enters France through Belgium or Luxembourg. There is no natural obstacle. Three strong places only (Liège, Namur, Maubeuge), isolated, without any bond between them, and presumably easily reduced or masked at a small cost, mark the road to Paris by the convenient valleys of the Meuse and the Oise.

"Necessity has no law" an imperial chancellor had to say later. The "scrap of paper" of a treaty of neutrality was not going to weigh heavily in regard to the exigencies of strategy. Their decision once taken the Germans set to work. Just as in the course of twenty years they had perfected the Alsace—Lorraine network, and the lines adjacent, so in 1893 they proceeded to improve the lines of Rhenish Prussia ending at the Belgian frontier, thus showing definitely their intention to move further North the zone of concentration of part of their forces.

At the same time, breaking with the tradition of Moltke the German staff undertook the fortification of Alsace—Lorraine. The entrenched camps Metz—Thionville, Strasbourg—Molsheim, as well as the works of Neuf Brisach and Istein, allowed them, if necessary, to economize troops in the provinces of the empire so as to swell the mass operating through Belgium.

These different undertakings soon enlightened the best soldiers in Brussels and in Paris. No one doubted any longer the intentions of Germany as regards the Belgian routes, but there were differences of opinion as to the size of her offensive movement. Certain officers, notably the Belgian Generals Brialmont and Déjardin, expressed an opinion that the germanic invasion would cover with its wave the whole extent of the neutral kingdom, passing to the north of the Meuse. In France nearly all the military writers, notably Generals Langlois and Bonnal, considered, on the contrary, that the principal attack would take place in Lorraine, and that a simple flank guard would make free with the routes of Southern Belgium without crossing, or even reaching, the line Liège—Namur.

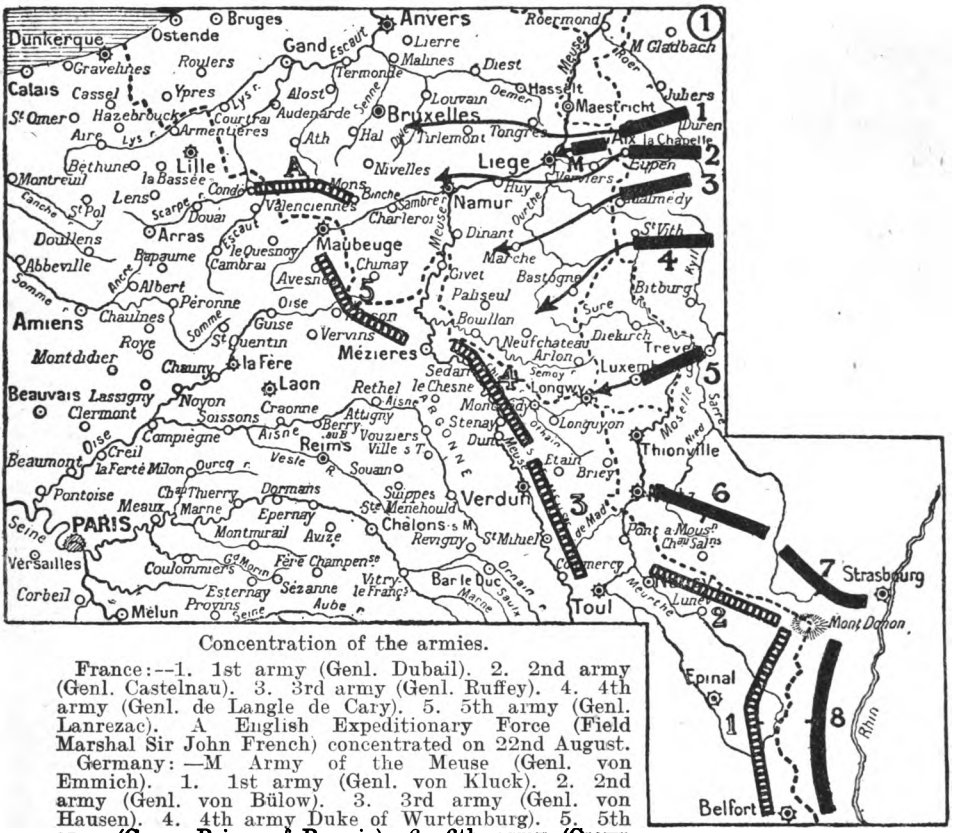
On the other side the offensive principles which had always been held in honour among us since 1870 made us seek to gain the initiative by attacking the Germans. But as we would not violate the neutrality of Belgium there was nothing else for us to do but to dispose a very important fraction of our forces towards the East, towards Alsace—Lorraine.

Grouping of the Armies and the first operations.

Thus the strategical doctrines of the two adversaries were to give a different character to the movements of their armies. The Germans were to try for a decision by a vast movement pivoted on Mont Donon with its marching wing across the Sambre and the Oise, while they remained on the defensive in Alsace. The French wanted to attack without delay on the whole of the Franco-German frontier.

The great units were grouped as follows:—

France distributed her first line troops in five armies: the 1st (Dubail) came into line on the Vosges, from Switzerland to Mount Donon: the 2nd (Castelnau)from Mount Donon to Metz: the 3rd (Ruffey) faced in the Woëvre the fortified region Metz—Thionville: the 4th and 5th (Langle de Cary and Lanrezac) formed on the Belgian frontier: the English army, only two corps strong, prolonged the extreme left of the line.



Concentration of the armies.

France:—1. 1st army (Genl. Dubail). 2. 2nd army (Genl. Castelnau). 3. 3rd army (Genl. Ruffey). 4. 4th army (Genl. de Langle de Cary). 5. 5th army (Genl. Lanrezac). A English Expeditionary Force (Field Marshal Sir John French) concentrated on 22nd August.

Germany: —M Army of the Meuse (Genl. von Emmich). 1. 1st army (Genl. von Kluck). 2. 2nd army (Genl. von Bülow). 3. 3rd army (Genl. von Hausen). 4. 4th army Duke of Wurtemburg). 5. 5th army (Crown Prince of Prussia). 6. 6th army (Crown Prince of Bavaria). 7. 7th army (Genl. von Heeringen). 8. Army detachment (Genl. von Demling).

Germany, who put into first line not only her active and reserve corps, but also territorial regiments, disposed of for the first general engagement, a mass of more than forty-four corps divided into nine armies. One alone of these armies, that of General von Deimling, much weaker than the others, had for its task to remain on the defensive behind the Vosges. All the rest of the enormous machine was concentrated between Aix-la-Chapelle and Strasbourg to converge on our North-Eastern frontier. It stood from right to left, the 1st (Von Kluck), 2nd (Von Bulow), 3rd (Von Hausen), 4th (Duke of Wurtemberg), 5th (Crown Prince of Prussia), 6th (Crown Prince of Bavaria), and 7th (Von Heeringen) armies. A provisional army in advance of the right wing, called the army of the Meuse (Von Emmich) composed of formations ready at once, was directed to

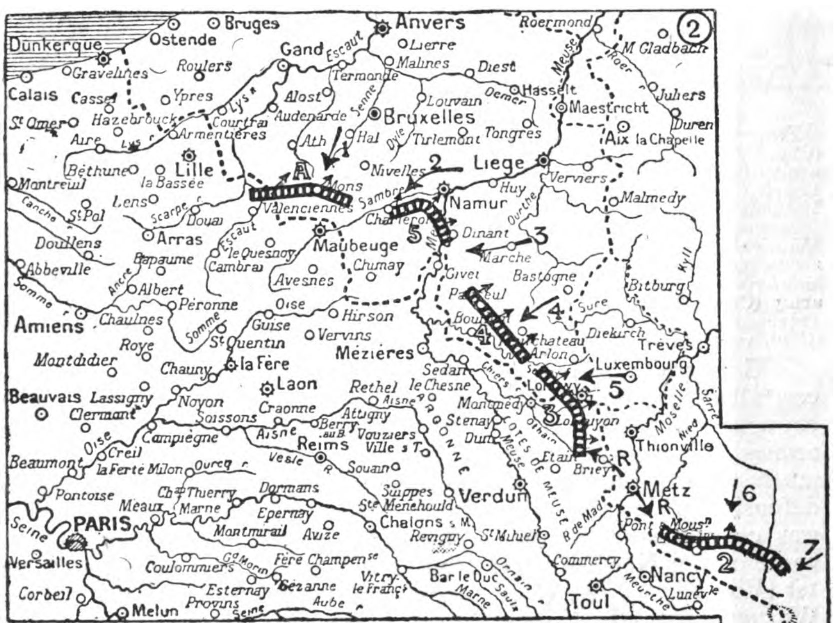
penetrate into Belgium on the expiration of the ultimatum addressed to King Albert, and carry Liège by an accelerated attack.

On the night 3rd/4th August the leading German troops crossed the Belgian frontier and the next day presented themselves before the Walloon fortress. The garrison, increased by a division and a half of the field army and vigorously commanded by General Leman, repulsed all assaults and covered the *glacis* of its works with enemy corpses. General von Emmich had to wait for heavy artillery to reduce the place.

Almost at the same time the French troops penetrated into Alsace. On the 7th August a brigade of the army Dubail threw back the German covering troops, and, next day, entered Mulhouse. Our light battalions seized the passes of the Vosges, and descended into the valleys of Alsace. In German Lorraine, General de Castelnau, in spite of two checks at Lagarde (11th and 14th August), took the offensive in his turn, and occupied, on the 18th August, the line Delmé—Morhange—Sarrebourg.

Lastly our left wing advanced. As the official *communiqué* of the 25th August told us, "the admirable effort of the Belgians" urged our armies to enter their country where, furious at the unexpected resistance which they encountered, the Germans tried to subdue that valiant nation by terror, burning towns and villages everywhere, and shooting inoffensive inhabitants during their passage.

From the 10th August our left wing made its dispositions for entering Belgium. The 3rd Army (Ruffey) quitted its position opposite Metz and formed towards the North-East, its right on the



The first general battle (20–23 August).
The thick arrow shows the general direction of the various German armies.
R Shows the offensive on the Garrison of Metz.

heights of Longwy, which permitted the army of Langle de Cary (the 4th) to pivot on its left: the 5th army (Lanzerac) established itself between the Meuse and the Sambre. Marshal French concentrated his troops in such a way as to lead them on the 23rd August between the Sambre and the Escaut, to the front Condé—Binche.

In Alsace, in Lorraine, as in the Woevre, where we had just thrown back a hostile raid at Mangiennes (10th August) the first contacts were favorable to us. Our cavalry, afterwards an advance guard of all arms, gained brilliant success at Dinant (15th August). But this was in a way merely a raising of the curtain. Faithful to their principle of accepting battle only with forces united, the enemy was preceded merely by weak reconnoitring detachments which did not engage deeply.

The first general engagement and the French retreat.

The real German army, after having detrained on the line Aix-la-Chapelle—Malmédy—Trèves—Metz—Strasbourg, advanced on an imposing front. General von Kluck (1st army), without troubling about the forts of Liège, the last of which did not fall until the 15th August crossed the Meuse below the town, beat at Aershot the Belgian field army which fell back definitely on Antwerp, and occupied Brussels on the 20th August. General von Bülow (2nd army) coming from the region of Eupen, crossed the river at Huy so as to deploy on the scene of the campaign of 1815, and bring down the line so formed towards the Sambre between Namur and Charleroi. General von Hausen (3rd army) and the Duke of Wurtemburg (4th army) from the base Malmédy—Saint Vith crossed the Ardennes on Dinant and Neufchâteau; to their left was attached the 5th army of the Crown Prince of Prussia, concentrated at Trèves and at Metz, through Luxembourg.

To the East of Metz, the army of the Crown Prince of Bavaria (6th) marched against the front of that of General de Castelnau who saw at the same time his right flank menaced, towards Sarrebourg by General von Heeringen (7th army) and his right by certain formations from the entrenched camp at Metz. In this region the general engagement began on the 20th August. Our troops, taken on three different sides at once, could not continue their advance: one army corps having given ground suddenly, this weakness entailed the recoil of the whole line. Supported by some reinforcements previously detailed from the garrison of Toul, and the army of General Dubail, General de Casteluan disputed the ground foot by foot, and definitely arrested the enemy's advance on the line of the Grand Couronné of Nancy and the Mortagne: but we had to give up nearly all the ground previously gained, notably at Mulhouse (27th August).

On the left wing, on the 21st and 22nd August, our 3rd and 4th armies dashed themselves against the German columns in Belgian Luxembourg. The *terrain*, heavily wooded, did not lend itself to reconnaissance either by airmen or cavalry: there was no field of view for the artillery. Our infantry, which allowed itself to be surprised in certain places, had to give way to numbers, and was thrown back

towards the frontier. This retreat uncovered the right flank of our 5th army, which, passing Charleroi and Dinant nearly reached to Namur! it fell back without very much difficulty. The English Expeditionary Force, obliged to follow the general movement, and pressed by the whole army of General von Kluck, found itself seriously compromised between Landrécies and Cambrai and only disengaged itself with loss.

Thus all was changed. To the partial advantages of the first days there succeeded a series of reverses on the whole battle front. What were we to do to remedy them, and re-establish the balance in our favour ?

A chief of ordinary capacity would no doubt have chosen a solid defensive position in rear, behind the Meuse perhaps, or behind the Aisne, or pivoted on the position of Reims. This common, easy, expedient, which comes naturally to the mind, and which necessitates a minimum of arrangement and activity on the part of the staff, generally does but retard the hour of the final defeat. The French Commander-in-Chief preferred to take a more energetic course, and not to meet his enemy again except as the assailant. Such a solution, as difficult to plan as to execute, could only be accomplished by taking room to manœuvre freely, and sacrificing a large zone of national territory. To retire rapidly without affecting the *moral* of the troops, to direct the army on the most favourable point, to stop it at the right time, neither too soon nor too late, and then resume the offensive, requires an infallible judgment and a most unusual strength of character.

Our retirement proceeded happily. Some vigorous thrusts, notably that of Lanrezac's army at Guise which inflicted a bloody check on the Guard and the 10th Prussian corps, slackened the pursuit: we stole away in all tranquillity to the line Paris—Verdun and beyond.

To the course determined on by the French Commander-in-Chief our adversary had to make a corresponding decision. Till then everything had succeeded with the Germans. Their armies, immense swarms of hundreds of thousands of men, seemed moved by clock work, faultless and certain. The mobilisation, the concentration, the deployment of the innumerable mass, its march across Belgium, had worked out in the smallest details conformably to the programme arranged beforehand. The irresistible rise of the tide had overwhelmed the courageous, but ephemeral, resistance of the Belgians, then, at the first push, had thrown back the Anglo-French forces, without suffering the smallest check, on a line more than 300 kilometres long.

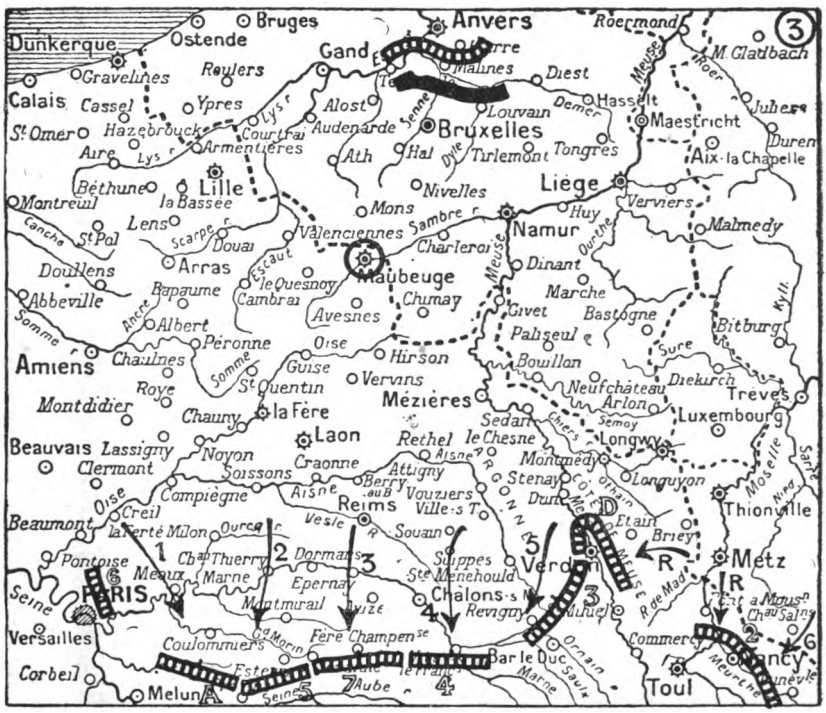
There was however a shadow to the picture. The Germans had reckoned that, thanks to their numerical superiority, to their more advanced preparation, and to the direction of their attack, they would take the Allies in reverse, and by enveloping the whole, or a part, of their forces would inflict on them a crushing defeat. This hope was disappointed. Not only had our armies not been annihilated, but they had escaped from their grasp, with serious losses doubtless, but unbroken, and preserving all their tactical connections. So the

campaign had not been finished on the first day by a clap of thunder. Contact lost it was necessary to take up the struggle under new conditions that the plan of campaign so carefully prepared at Berlin could not have taken into consideration.

The Victory of the Marne.

The invading army came down southwards; its right wing found Paris on its route. Here was a tempting prey notwithstanding the defensive works of unequal value which marked out the huge perimeter of its entrenched camp. What course were the Germans to take? Should they employ a part of their forces to attack the French capital, or should they keep them strictly entire to destroy our army which continued its retirement on the Marne and Ornain?

The German doctrine of war is based on a certain number of principles which always dictate its conduct. One of these holds that one should neglect geographical objectives, consider only the field army of the enemy, and leave it no intermission or rest until it is annihilated. But the offensive against the French army presented fewer advantages than in Belgium; to reach it it was necessary to follow it between the strong places of Paris and Verdun which rendered the favourite German manœuvre of envelopement impossible. On the contrary the German army in its turn ran the risk



Situation of the armies on the 5th September.

Two new French armies—6, Genl. Maunoury's army; 7, Genl. Foch's army. The 5th army (Lanrezac) has been placed under the command of Genl. Franchet d'Espérey, and the 3rd army (Ruffey) under the command of Genl. Sarrail.

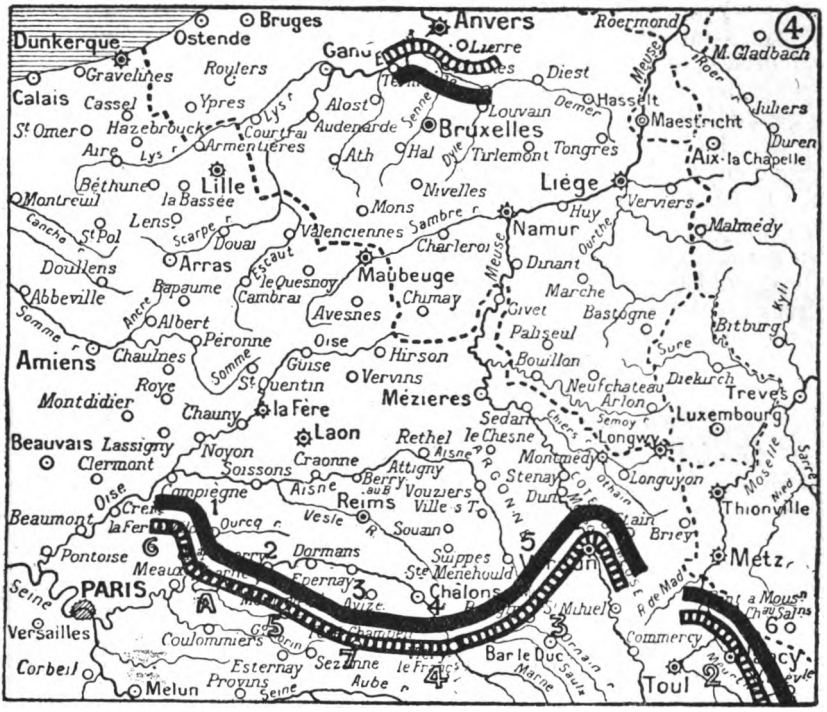
of envelopment, our two entrenched camps opposite its wings playing the same part as Metz did in regards to the armies of de Castelnau and Ruffey in the month of August.

In this awkward situation the Germans made a false appreciation of the situation. They did not suspect the skill of our Commander-in-Chief's manœuvre but attributed our rapid withdrawal to complete demoralisation. Against an enemy in flight there is no need of precautions. It is enough to rush on him by the shortest road, as the veteran Moltke did at Sedan, and reach him, to disperse or capture him. Thus the Germans decided the question. Their marching wing bent to the South-East and their five armies, by forced marches, thrust into the passage between Paris and Verdun.

This was the mistake General Joffre was waiting for. He had at first intended not to stop until on the Seine, but on the 5th Sept., seeing the enemy completely entangled between our two fortresses, he determined to pass to the offensive as soon as possible.

The last days of the retreat had been put to profit by reinforcing our line in Champagne with units withdrawn from our armies in the East, and by calling up reserve corps which had not been employed in Belgium. In this way it had been possible to form two new armies: that of General Foch, which was inserted between those of General Franchet d'Espérey (who had replaced General Lanrezac) and Langle de Cary: that of General Manoury on the Western extremity of the front. This last army, pivoting on the entrenched camp of Paris, was to face to the East, and attack, on the Ourcq, the German right wing in reverse. The 3rd army under the command of General Sarrail who had replaced General Ruffey, was ordered to rest on Verdun facing West, and by a symmetrical movement to fall on the flank of the Crown Prince of Prussia: the centre composed of the English forces, and the armies of Franchet d'Espérey, Foch, and Langle de Cary were to march against the hostile columns on the front Meaux —Vitry le Francois.

Thus commenced on the 6th September the Battle of the Marne. The Germans, disconcerted at first by this general attack which they had not foreseen, soon regained their steadiness, and exerted themselves while warding off the flank attacks to break the French line, their principal effort being directed against the army of Foch. This army not only made head against the 3rd German army but succeeded, while actually engaged, in grouping on its right some troops from its left, and flanking its opponent, threw it back in disorder across the difficult ground of the marshes of Saint-Gond. On the left Marshal French and General Franchet d'Espérey threw the enemy across the Grand Morin and the Marne: on the right Langle de Cary gained ground equally. On the wings the army of Manoury despite the desperate attempts of General von Kluck to drive it back and turn it on the North, succeeded, thanks to the arrival of a reinforcing division, in maintaining itself in a threatening position on the Ourcq, while between Verdun and Révigny the army of Sarrail, at the cost of heavy losses heroically endured, fixed before it the forces more than double, of the Crown Prince.



Situation of the armies on the 9th September.

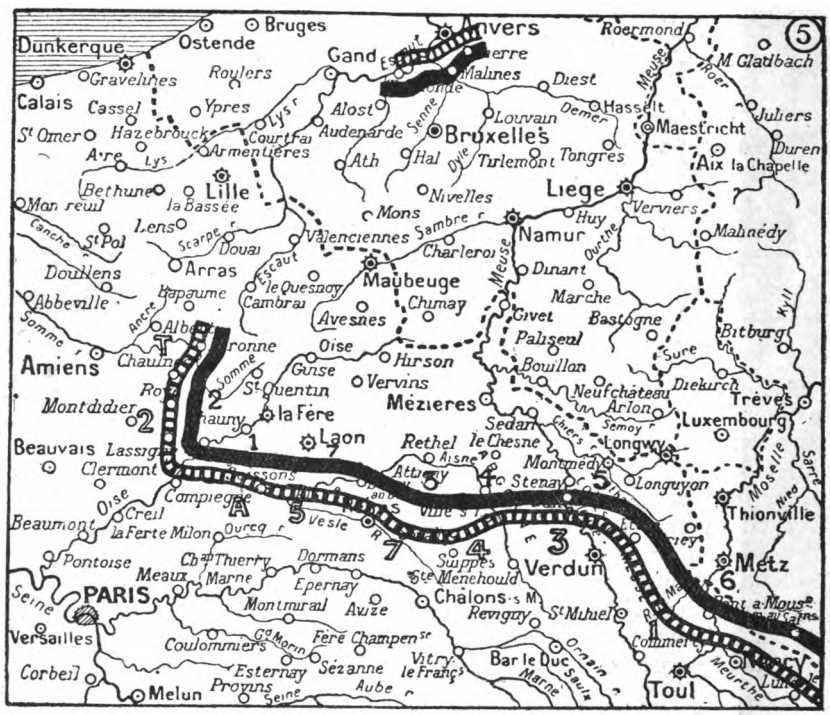
On the 9th September the retreat of the Germans is general. In their haste to escape the jaws of the vice which they feared to see close on them, they covered the roads with stragglers and stores. Our troops wearied by the weeks of marching and constant fighting are no longer in a state to change defeat to disaster. The enemy profited by this respite to halt on the heights of the Aisne and to organise a defence between the Oise and the Meuse (below Verdun). Violent fighting took place on this front: action crystalised there little by little, each side consolidating its points of support, deepening its trenches, multiplying its accessory defences. To the war of movement succeeds the war of positions.

From the Aisne to the Lys.

The battle of the Marne restored the balance between the two adversaries. Neither appeared to be within reach of decisive victory. The Germans held a part of our territory but their plan of campaign had miscarried. And yet they had to conquer and conquer quickly. If the war degenerated into a struggle of attrition, germanism, weaker in men and resources than the Allies and powerless on the sea, is beaten in advance. The Prussian generals and statesmen know it: they have said it and written it a hundred times. Attack, attack in order to profit by the advance made, attack before the Russians and English can instruct and mobilise their inexhaustible reserves, attack

to paralyse the danger of intervention by hostile neutrals, attack always, it is the only plank of safety: Germany will attack to her last breath, and when she ceases to attack will founder at a blow.

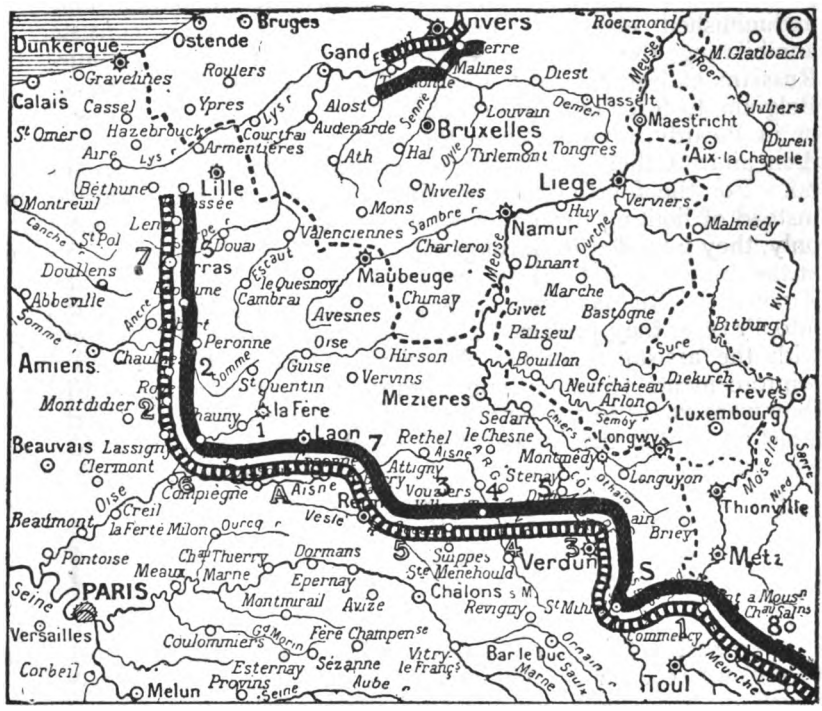
If the last battle had been lost it was because the assailants had neglected the principle of envelopment and, instead of turning the French, had fought on ground where the flanks of their own army were compromised. The chance lost on the Marne might be retrieved on the Aisne by manœuvring more sensibly, by putting into practice another principle forgotten up to now, that of the economy of forces. No general offensive on all points. A defensive action in the centre would hold the enemy, and make it possible to assemble formidable forces on the wings, and to flank the hostile line. The third phase of the war commenced.



Situation of the armies on the 21st September.
T Shows the Territorial groups of Genl. Brugère.

The right flank of our principal army then rested on the place of Verdun, and on the defences of the Heights of the Meuse which connect Verdun with Toul. A first German attack starting from Metz had set foot on the borders, but had just recoiled from before Fort Troyon. The enterprise, renewed some days later with considerable forces—about four army corps constituting the "army detachment" of General von Strantz—succeeded, thanks to a powerful force of siege artillery, in reducing the fort of the Roman Camp (26th September), in crossing the Meuse at St. Mihiel, and in pushing

on as far as the valley of the Aire. There the success of the enemy was arrested. Our troops, converging on the column which had passed the Meuse, threw it back on the river.



Situation of the armies on 30th September.

S Detachment of the army of von Strantz operating on Saint-Mihiel.

The operations against our right flank were only a simple diversion compared with the more important action, renewed without relaxation, against our left flank. The enemy switched off to the West all reinforcements coming from Germany, and all the units that he could levy from the rest of the line especially from the region of Nancy and from Alsace. But to the German movements the effective parallel movements of the French corresponded. On the chess board of Champagne the adversaries castled at the same time. Our headquarters, which had foreseen the intention of its antagonist, thwarted his attempts as they took place. Not only did not the Germans succeed in enveloping us, but they were unable to prolong their line further West. We obliged them to throw it back to the North and to mount higher and higher in this direction, their new line becoming perpendicular to the first, and describing a gigantic L which was soon to reach from the North Sea to the Vosges, having its angle at the confluence of the Aisne and the Oise.

Le Bulletin des Armées de la République, in its *resumé* of the 5th December very appropriately called this period of the campaign the "Race to the sea"; there the railway and the automobile played as active a part as the rifle or the cannon. From the beginning of this race the Germans understood that they would not win it. Once

again it was necessary to find another way, to think out some more efficacious method of making an end of the Allies.

In one respect the Prussian General Staff deserves justice. Repeated failure left them unmoved in their determination, and with undiminished ardour. The strategic plan which consisted in annihilating the French resistance and then turning against the Russians had miscarried. They had not been able to surround us in Belgium, to force our lines on the Marne, or to turn us on the Aisne, or in Picardy. Three times the German manœuvres had failed in their aim. Others might have been content to stop. The Germans no. For the fourth time they intended to take the offensive, and instead of limiting this offensive to one of the theatres of operations only, they intended to develop it in both, and try to obtain a decision at the same time in the East and the West, in Poland and in Flanders. Against the Russians, whom they just defeated easily in a bold raid into Prussia, they prepared a general invasion in five heavy columns with the assistance of the Austrians. Against the French whose reinforcements were pushing higher and higher towards Flanders they were going to try, before allowing them to reach the North Sea, a last attempt at envelopement with such a mass of troops as to sweep away all resistance. If the manœuvre should succeed it would deliver to the victors the ports of the North Sea, and the Straits of Calais, bases of action against Great Britain. Thus the new dispositions of the Germans took into consideration together the three powers which were fighting them, Russia, France, and England.

The Battle of Flanders.

To realise this grandiose conception it was necessary first of all to proceed to clear up Belgium. The field army of King Albert, of which the main body was at Antwerp, held the approaches to that entrenched camp as well as the crossings of the middle Escaut and the Lys. The first objective then was Antwerp, the defences of which passed for a model of permanent fortification, with the double belt of works, the long range guns, and the zones of inundation which could be extended in front of the approaches.

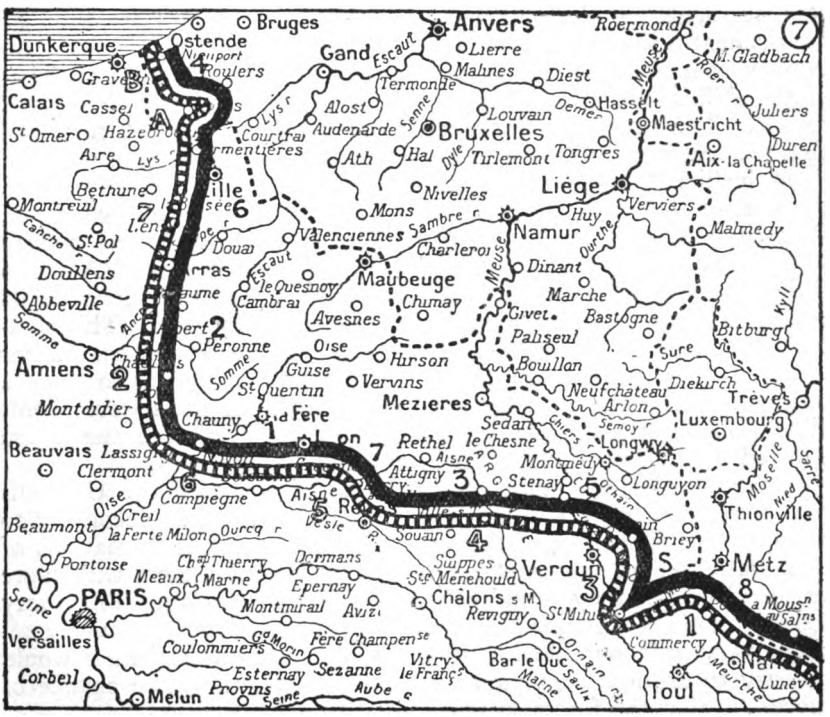
The fall of Maubeuge on the 7th September had made available the giant siege guns which had before reduced Liège and Namur. On the 26th they were in position before the Southern sector of the entrenched camp of Antwerp. The Belgian troops bravely sustained the bombardment, but maintained a defensive attitude instead of trying to force the enemy's infantry and silence his guns. Nothing could hold out against the monster projectiles of the twelve and sixteen inch mortars. Armour and masonry are crushed by the explosion of their shell. A large breach is opened in the outer girdle of forts. The German infantry pushes in and maintains itself there. From that time Antwerp is lost. In vain a brigade of English marines arrives to succour the place. It is too late. As soon as the batteries are brought nearer they level with the ground the works of the second line. The end is near.

On the 9th October the defenders evacuated the town and made good their retreat by the narrow strip of land between the Escaut and the Dutch frontier. When the Germans broke in, near Termonde to the North of the river, the greater part of the Belgian army is in

safety: the rear guard only, being cut off, entered neutral territory where it was disarmed.

By possessing themselves in a few days of Antwerp, *chef-d'œuvre* of the celebrated Brialmont and one of the largest and strongest entrenched camps in the world, the Germans had achieved an astonishing success which at first sight appeared overwhelming: but a careful consideration strangely reduces its value. A fortress is generally intended either to prevent access to a district without natural defences, to bar a defile, a road, or a railway. The fortress of Antwerp had a special, a unique, character. It had been constructed not in the neighbourhood of the threatened frontiers, but, on the contrary as far from them as possible. It was intended to serve as a "national keep", a place of refuge for the Belgian army in case it could not keep the field. It follows that the value of the captured camp would have been doubled by the capture of the army which had sought shelter in it. The siege army by attacking the forts on the right bank of the Escaut before making good the investment on the left bank had committed a gross error which allowed the Belgian army to disengage itself. The victory remained incomplete.

The Germans followed their opponents at some distance: Ghent, Bruges, and Ostend fell into their hands without fighting: but, behind the Yser, the Belgian troops rallied, and arrested their advance. On this river with its flat banks, which runs sluggishly through a



Situation since 15th November.

B The Belgian and French armies of General d'Urbal placed with Nos. 7 and 2 armies under the chief command of General Foch. The army designated by the figure 7 has passed under the command of Genl. de Maud'huy.

low-lying district cut into squares by dykes and canals, the great game was to be played. There was to be decided the fate of Dunkirk, of Calais, and of Boulogne. There was to fall the torrential attack on the allied left. The troops to be employed in it were chosen beforehand. There was no desire to commit this unrestrained, reckless, offensive to men already fatigued by two months of warfare. Fresh contingents, newly formed *corps d'armée* composed expressly of volunteers, youths as yet ignorant of the horrors of war, were to be launched against the trenches of Flanders. The flower of the Berlin youth, enthusiastic and ignorant, unskilful with the rifle but glutted with promises of reward, and intoxicated with warrior songs, were to charge blindly on the enemy, and at any cost open a road to Calais, the supreme goal indicated by the imperial order.

Opposed to them the Belgian army, supported on its right at Dixmude by our marine fusiliers, flanked on the left by the light Anglo-French flotillas, calmly awaited the attack.

A formidable bombardment prepares it: then when they judge that the defenders are sufficiently shaken by the showers of heavy projectiles, the german foot advance on the whole front from Nieuport to Dixmude. These inexperienced troops scarcely know how to make use of the ground, or how to fight in extended order. A strict close order discipline is necessary for them to keep direction. Like their ancestors, the Prussian grenadiers of Valmy, in deep solid masses these recruits enter the furnace. The shells open breaches in this compact mass but the gaping holes are soon filled. Then the rifle fire decimates the heavy columns: the machine guns mow down their ranks with inexorable precision: on the point of reaching the trenches of the Allies, the attack comes to a standstill, wavers, breaks, and recoils. Ten times the Germans stoically reform, and return to the charge: ten times their regiments melt away under the fire. One of them, luckier than the others, profiting by a moment of lassitude on the part of the Belgians, crosses the river, and carries the village of Ramscapelle, obliging the line of defence to fall back to the railway some hundreds of yards to the West. A reinforcement of Algerian Rifles counter-attacks vigorously, and charging to the sound of its bugles, retakes with the bayonet the post so hardly won. This combat put an end to the desperate efforts of the Prussians. After fifteen days of unprofitable assaults they gave up trying to force a passage. After the 28th the fusillade ceased, the guns were silent. When, on the morrow, the Belgians broke the dykes the inundation covered only corpses and a few guns stuck in the mud.

The sterile hecatombs of the Yser did not turn the Germans from their projects on Calais. Their defeat was due, according to them, to the difficulties of the ground and the vicious formations of their battalions of conscripts. At a point better chosen, with more seasoned troops, they would take a striking vengeance. They very sensibly noticed that our line round Ypres curved in a convex semicircle, very unfavourable for defence. Against this salient it would be easy to arrange convergent attacks with all the more chance of success in that the forces were exposed to enfilade fire.

At the end of October the Germans had concentrated opposite their objective imposing forces, among them two army corps of picked troops: the 15th from Strasbourgh always held in leash on

the French frontier, and the Guard, whose steadiness and alacrity had not been weakened by the heavy losses experienced at Dinant, at Guise, and in the marshes of Saint-Gond.

On the 30th October from North, East, and South, the columns of attack are hurled on the positions of the Allies. The French and English troops which guarded the ancient Flemish city did not allow themselves to be shaken. The struggle was as bloody as on the Yser and had the same result: every time the enemy carried a trench a counter-attack rushed him out. On the 11th November a particularly energetic push of the Prussian Guard pierced the British front and gained the Southern outskirts of Ypres, but could not maintain itself there, and gave way before the English bayonets. It was the culminating point of the battle. After the check of the Guard the intensity of the crisis decreased rapidly. On the 15th there is a general calm: the discouraged Germans did not leave their lines. It is no longer a question of taking Calais. The fourth phase of the war is ended by a fresh and grievous reverse to the German arms.

Calm.

The last six weeks of the year saw no general offensive against our armies. From Switzerland to the North Sea only affairs of detail were undertaken, local attacks of small scope. The enemy maintained a defensive attitude in the Western theatre of operations, and only showed activity in Poland. After four months of war, after four successive attempts, he abandoned the plan of campaign prepared for twenty years with method and persistence; he even adopted a course contrary to it. All his disposable elements took the road to the East to reinforce the armies of Field Marshal von Hindenburg, who possessed all the confidence and bore all the hope of the nation. On him was imposed the ungrateful task of putting the Russian contingents out of the field. This determination was certainly arrived at as a mere counsel of despair, as a last resource, for it was known at Berlin as elsewhere that, altho' the offensive capacity of the Russians has sometimes been questioned, their defence is unbreakable, especially in the interior of their country, and in the heart of winter.

In arriving at this reversal of her strategic doctrine it is obvious that the military power of Germany has suffered a severe blow. Its *prestige* is suspect, its effective force reduced, its arrangements upset. In the secondary theatres of operations fortune no longer smiles. In Serbia its ally has experienced a veritable disaster: in the Caucasus the Turks are powerless: the Colonies in Africa, Asia, and Oceania have fallen into the hands of the Allies: the raiding cruisers, hunted without mercy, have finished their bold career, while the Austro-German fleets, blockaded in their fortified ports, do not attempt to dispute the empire of the seas with the hostile squadrons.

1915 brings to the Allies the most magnificent promises. During the campaign of 1914 they have fought without weakness, always with valour, often with good fortune! more prudent than their adversaries they have known how to economise their resources and have succeeded under fire in correcting their initial mistakes, then in filling up the gaps in their organisation. The grain sown will soon spring up: the new year will see rise towards heaven in serried Champanbert ears the golden harvest of Victory!

RADIOACTIVE & LUMINOUS COMPOUNDS.

BY CAPTAIN A. E. MACRAE, *pac.*, R.A.

DURING the present war much use is being made of luminous agents for illuminating watch dials, compasses, etc., and the introduction of a radioactive compound for the illumination of gun sights for night work calls for a few notes on luminous and radioactive materials used for these purposes.

By a radioactive material is meant a substance, of which uranium, thorium, and radium are the best known samples, which is capable of spontaneously emitting special types of radiation.

There is no doubt that in future greater use will be made of radioactive compounds for the illumination of sights scales, readers, etc., and it is hoped that this article will be of interest to artillery officers, enabling them to understand the properties and effects of the materials used.

Almost everyone is familiar with the lavender colour glow or green colour given at night from the luminous patches on a watch dial, or compass, and one often hears these patches spoken of as radium paint. Where the luminosity appears lavender there is no radium in the paint, and the luminosity is obtained by this 'daylight' paint storing up daylight and emitting the same at night. Paint giving a green coloured luminosity contains a small percentage of radium or meso-thorium.

These 'daylight' or luminous paints will be considered later.

The discovery of radium makes it possible to produce luminous compounds which are quite independent of daylight excitation, as the necessary energy is being given out continuously by the radium rays, which on being absorbed by certain crystals give out their own characteristic light.

The questions immediately presenting themselves are:—

What is radium ?

How and from where is it obtained ?

What produces the luminosity in radium compounds ?

I hope in the following pages, not only to answer these questions, but to give in elementary detail other properties of radium.

The starting point of Radioactive Transformations was the discovery by Röntgen of the X-rays in 1895, and Lenards experiments on Kathode rays. It will be as well if a short description of what these rays are be now given, as it is found there is a close analogy between these rays and those emitted from radium and other radioactive bodies.

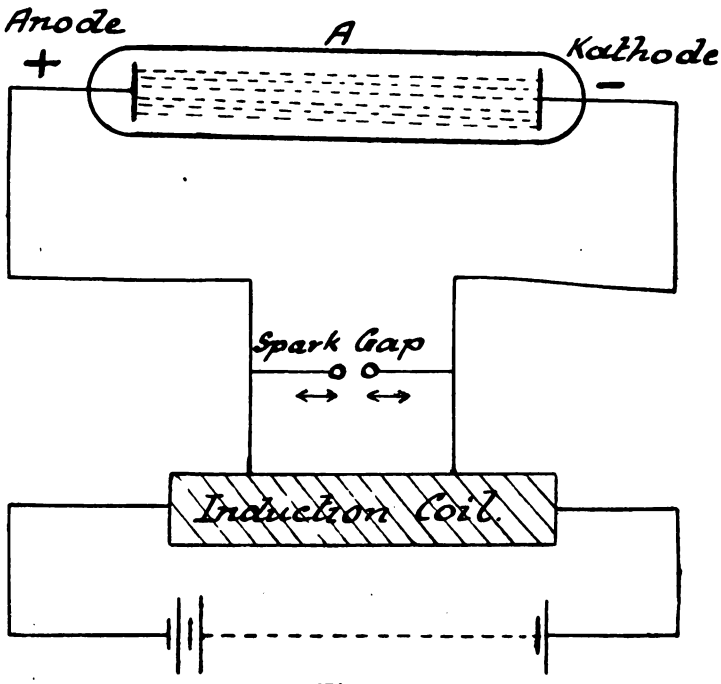


Fig. 1.

If a sealed glass tube 'A', attached to an air pump, is connected, as shown in Figure 1, to an induction coil and battery, an electrical discharge will pass through the tube if the spark gap is properly adjusted.

As the air pump exhausts the air from the tube the following changes take place in turn.

1. A reddish glow, known as the 'positive column', begins to fill the tube.

2. The column breaks away from the kathode forming a dark space called the 'Faraday Space', the kathode becoming covered with a luminous patch.

3. The luminous patch leaves the kathode forming a second dark space called 'Crooke's Space', and the red column becomes broken up.

4. The whole of the interior of the tube becomes dark but with a phosphorescent glow on the inside of the tube, the colour depending on the nature of glass used—green with soda glass and blue with lead glass.

Experiment shows that at this stage the discharge through the tube is a stream of particles charged with negative electricity and projected from the kathode normally to its surface, together with a stream of much heavier positively electrified atoms proceeding from the anode to the kathode.

The kathode rays on striking a metallic surface give rise to a new kind of ray called the X-ray or Röntgen ray.

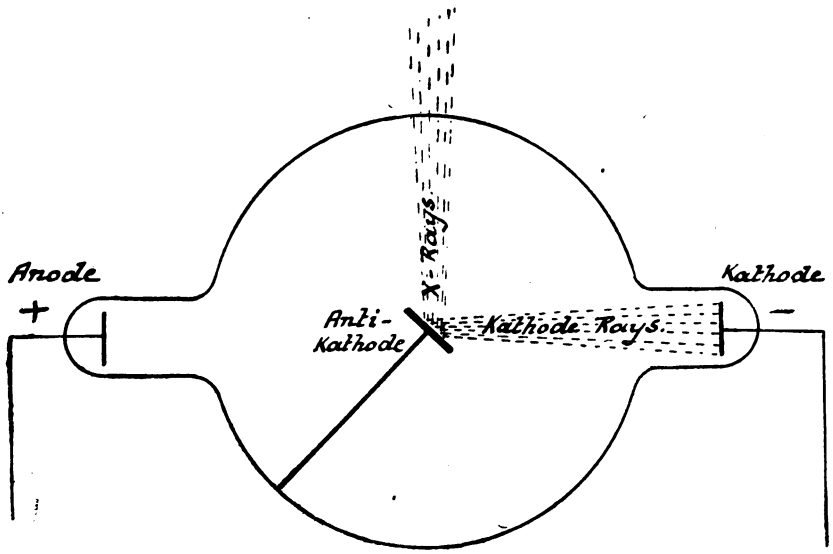


Fig. II.

Recent research proves apparently conclusively that X-rays are light waves but very much shorter than the shortest visible light waves. The kathode rays consist of a stream of particles called 'corpuscles' or 'electrons' moving with great velocity, carrying negative charges of electricity, and possessing apparent mass only about $\frac{1}{1000}$ that of an atom of hydrogen.

1. Radium, and Radium Compounds.

After the discovery of the X-rays further research proved that the radiations emitted from uranium were similar to X-rays in their penetrating powers.

Uranium is a metalic element of atomic weight 239 and specific gravity 18·615. Compounds of this metal were prepared by Klaforth in 1789 from pitchblende, and called uranium after the planet Uranus, then recently discovered. It occurs always in combination, usually in pitchblende, as an oxide, $U_3 O_8$ with silica, together with oxides of tin, lead zinc, etc., and can be prepared by heating a mixture of uranium chloride, salt, and sodium in a closed iron cylinder.

The metal is lustrous, hard, silver white in colour, somewhat malleable, and can be volatilized in an electric arc. If left standing in air it becomes coated with a blue oxide and will burn if strongly heated in air.

Uranium is usually chosen as a standard for 'activity' of radio-active substances, owing to the constancy of its radiations, so that when the activity of radium is said to be about two millions, it means that the electrical effect due to it is about two millions times as great as the corresponding effect produced by an equal weight of uranium spread over an equal surface.

After this property of uranium was known a systematic examination of the natural minerals containing uranium was made by Mme. Curie, and two very active substances were found to be present. One of these was separated with bismuth and called polonium, in honour of the country of Mme. Curie's birth, and the other, which was separated with barium, was called radium.

The chemical properties of radium are closely allied to those of the element barium, and the radium can be readily separated from the radium barium compound by taking into account the differences in solubility of the chlorides and bromides, that is by a process known as fractional crystallization. The quantities of radium compounds are small, and owing to their great cost it is exceedingly difficult to obtain radium in a metallic state, although in a metallic state, there is not the slightest doubt it is radioactive.

Radium exists in very small quantities in radioactive minerals, and it is found that the amount is proportional to the uranium content in the minerals. The amount of radium per ton of uranium is about 0·35 gram, or less than one part in a million of the mineral. From this it will be seen that the quantities available are exceedingly small, and the cost of extracting the radium from the minerals very great. Other radioactive substances have since been discovered but none of these active bodies, except radium and polonium, have been obtained in a pure state.

Radium may therefore be considered a metallic element, or at least a substance possessing all the characteristics of an element, capable of giving out energy in the form of radiation without indicating any means of initially storing this energy. It is known also that this energy is given up without the slightest sign of exhaustion. The atomic weight of radium was found by Mme. Curie to be 225.

Immediately the radioactive property of radium was known extensive research work was carried out to determine the nature of the rays emitted from the substance.

It must first of all be distinctly understood that the rays emitted by radium are invisible, and their existence can only be determined by their effects. A clear conception of what these rays are, together with the characteristics of their effects, must be thoroughly understood before proceeding to deal with the production of the well known luminosity obtained from radium compounds and employed for military and naval purposes.

It was found that three rays were emitted from radium, and these were called α, β, and γ rays. (Alpha, Beta and Gamma).

The α — rays consist of particles, charged with positive electricity, projected with a velocity of about 20000 miles per second, and having apparent mass of about twice the hydrogen atom.

The β — rays consist of particles charged with negative electricity, projected with a wide range of velocities, the maximum being about that of light, and having apparent mass of 1/1000 of the hydrogen atom. These rays are found to be identical in all respects, except in velocity, with the ray particles projected from the kathode in the vacuum tube described above.

The γ — rays are very similar in general properties to the X-rays described in the first part of this article, and according to present views these rays must be considered as a type of wave motion in ether. They are probably pulses set up by the mission of the β — particles.

Each of these rays falling on other substances give rise to secondary rays, and these secondary rays in turn produce tertiary rays, and so on.

To separate the radium rays a particle of radium is taken and a strong magnetic field applied at right angles to the α, β, and γ rays, that is at right angles to the plane of the paper. The α — rays are deflected to the left, the β — rays are bent to the right, and the γ — rays unaffected as shewn in the following Figure III.

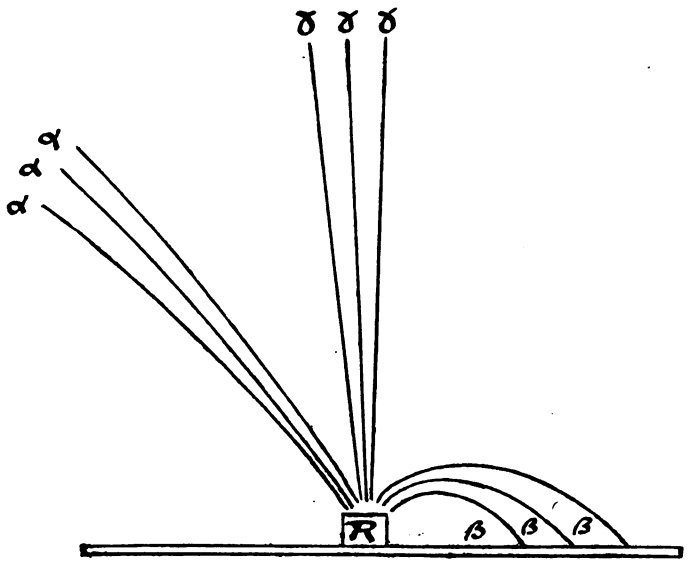


Fig. III.

The α — rays can be completely stopped by a layer of aluminium about ·05 mm. thick, the greater part of the β — rays by 5 mm. of aluminium, while a thickness of about 50 cms. of aluminium would be required to absorb most of the γ — rays. The average penetrating power of the three rays therefore is approximately in the ratio 1 : 100 : 10000.

I have stated that the particles of the α — rays and β — rays have mass and velocity. Rutherfords table (Fig. IV) below shows the relation between mass, velocity, and kinetic energy of the average α and β particles, the volume of a sphere representing the mass and energy, and the length of line the velocity. It is quite clear from this table that the average β — particle has a much greater velocity than the average α — particle, but on account of its relatively small mass its kinetic energy is a great deal less than the average α — particle.

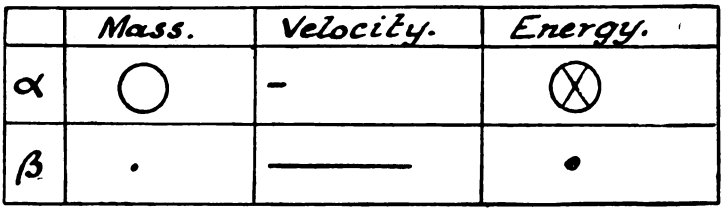


Fig. IV.

In 1900 Rutherford discovered that in addition to radium emitting the α, β, and γ — rays it also emits a radioactive emanation or gas, and these emanations consist of gaseous radioactive matter, the radioacting power of which dies rapidly away. Radium was then said to have an emanation period of 3·8 days, and by this is meant that the time taken for its activity, measured by its radiation and the radiation of its products, to fall to half value, was 3·8 days; 'activity' being defined as the intensity of the effects of the three rays.

At present radium is supposed to have a half period of two thousand years, and it is evident that all the radium existing in the world is in slow transformation into other kinds of matter. This period is very short in comparison with geological epochs, and the fact that radium occurs in pitchblende shows that it must be evolved from some source. It appears therefore that radium is a product of some other element of small radioactivity and exceedingly long period. The only elements possessing these characteristics are uranium and thorium, and considering all conditions, uranium is looked upon as the parent of the element radium.

What is also the final product of radium ? It is quite evident that this product not being radioactive must be a stable product or element. Pitchblende contains lead, and if this is the final product the amount of lead in uranium minerals should be in constant proportion to the uranium content. There is some evidence that the proportion is constant and this is very suggestive that lead may be the final product of radium.

The α — rays are the most characteristic and important of the three rays emitted from radium, although this was not fully recognised at first. As already pointed out the β — rays and γ – rays possessed greater penetrating power, and consequently most of the experimental work was directed towards the study of these rays. The α — rays show a remarkable power of causing a fluorescence in many chemical compounds, and also some metals. With willemite, which is a silicate of zinc, a green fluorescence is emitted when exposed to the intense radiation of radium. Diamonds also show a luminosity under similar conditions. It has been found however that the compound which possesses the greatest sensitiveness to the α — rays is crystalline sulphide of zinc, which glows a very vivid green when subjected to the α — rays of radium. This fluorescent glow appears as a diffused and continuous luminosity, extending uniformly over the surface, or in some cases throughout the volume, of the substance. How this glow is thought to be obtained will be considered later.

Another important property possessed by the α — rays or particles is ionzation, and by that is meant, these particles are capable of producing ions or electrons, which may be looked upon as 'carriers,' charged with positive or negative electricity.

A given mass of radium continually maintains itself at a higher temperature than its surroundings. This effect is no doubt due almost entirely to the energy of the particles being converted into heat. I have pointed out that these α — particles are easily stopped by a solid substance, and consequently radium may be considered opaque to its own α — rays unless it is spread out in a very thin layer. To obtain therefore a maximum radiation of α — particles, as much surface as possible must be exposed, as only the α — particles from this surface can get clear. Radium is of course active throughout its mass, and consequently much of the activity of the α — particles is not evident externally owing to the particles being stopped within the mass. The energy is still there, and consequently heat is generated being manifested by an increase of temperature. If a sample of radium is sealed in a glass tube the α — particles are stopped by the glass of the tube, but these α — particles being charged with positive electricity, the inner surface of the tube acquires a positive charge of electricity which increases with time. In a tube containing a quantity of radium the electrical charge in time would cause a spark in opening the tube. When radium compounds of high active properties are permanently sealed in a tube, a means of relieving the stress must be provided by fusing a piece of platinum wire through the glass, otherwise the charge might in time become great enough to fracture the glass. The α — ray activity is an unalterable property of radium itself without regard to any active products which the radium may evolve.

A sheet of metal that will completely stop the α — particles will leave the β — particles unaffected, but it is found that one cm. of lead is sufficient to stop all β — particles, and this must be considered the minimum to completely eliminate the β — particles. β rays being like kathode rays produce vivid fluorescence in many substances including several minerals. Willemite, as well as glowing from the effects of the α — rays, will glow with the same greenish hue when affected by β — rays. Diamonds show a distinct fluorescence, but it is quite probable that the other rays are also contributing to the observed effect. Substances like organic compounds are mechanically disintegrated after a long exposure to ordinary radium rays. Paper and indiarubber, after being wound around tubes containing radium compounds, become rotten. This is largely due to the β — rays and it is also possible that certain harmful physiological effects are due to these rays. The glass of a sealed tube containing radium does not prevent the β — rays from passing through it.

The γ — rays or radium have an almost incredible power of penetrating matter, and it seems impossible to assign a limit to the penetration of the rays. It is also found that the γ — rays are invariably emitted from the radium with a simultaneous expulsion of β — rays, and there is good reason to suppose that the γ — rays result as a secondary effect from the sudden positive acceleration

experienced by the β — particles when emitted from the active substance.

As I have stated before, besides the three rays given off by radium, there is also an emanation of gaseous radioactive product emitted, and this emanation is characterised by its high activity. Inactive substances if placed near uncovered radium become very active, by reason of a deposit from the emanation on the exposed surface, and on the removal of the radium the activity remains for a considerable time. If however the radium is in a sealed tube there is no escape of the emanation and the inactive substances do not become active.

The activity of the radium emanation decreases considerably in a short time after being emitted, and as I have said before the activity falls to half in about 3·8 days. The radium itself, which has emitted the emanation, spontaneously regains activity at the same rate as the emanation loses it, and eventually recovers its original intensity of radiation. The deposit from emanation, which causes the inactive objects in the neighbourhood of radium to become radioactive, is considered an invisible film of solid active matter, the gaseous emanation itself emitting only α — rays, but the active solid deposit emitting α, β, and γ — rays. The radium itself immediately after the removal of the emanation emits only α — rays and retains about 25% of its original activity, 75% of its activity being due to its emanation and the products arising from it.

It will be seen that the radiation of radium is very complex in itself, and arises from a complex source. A further analysis of the question is not possible in this article.

The following table summarises in elementary form the results so far obtained.

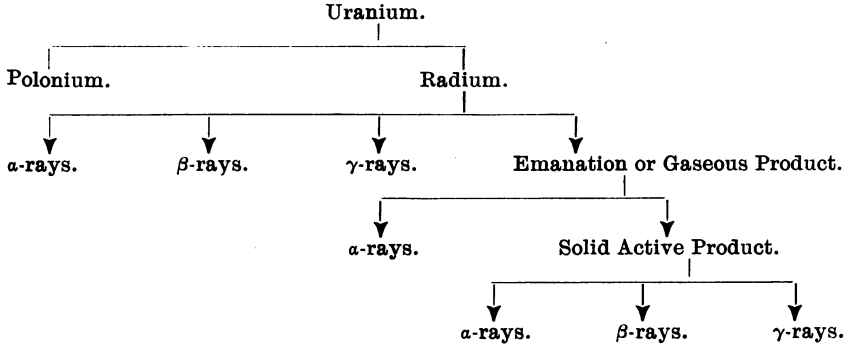


Fig. V.

Now comes the question of how the luminosity is obtained in a radium compound, and in considering this question I shall deal with a radium compound as a mixture of radium, in the form of radium bromide, and sulphide of zinc in the form of crystals.

I have dealt in elementary detail with the three rays emitted by radium and the emanation, which in its turn ultimately emits α —, β —, and γ — rays, but in discussing the production of luminosity

it will be sufficient in this article if I deal with the action of the α — particles only, as it has been found that 90% to 95% of the radiation obtained from radium and its products is resident in the α — particles, the remaining 5 to 10 per cent being due to the β—, and γ – particles. There is no doubt that the β —, and γ – particles do their share in creating luminosity, but the subject is a very complex one, and although the study of these rays and their effects is extremely interesting, it is not proposed to deal with them further in this article.

If we look upon sulphide of zinc as a substance made up of a very great number of atoms, which can be split up into ions or electrons on being bombarded by something with sufficient energy, the action of the α – particles from the radium in the compound considered may be discussed as follows.

From the table, Figure V above, it will be seen that more α — particles are emitted from the radium and its products than anything else, and I have already stated that these particles possess mass, travel at a great velocity, and therefore have kinetic energy. In addition the particles are charged with positive electricity. In the compound under consideration the α — particles bombard the crystals of zinc sulphide and ionise them, that is release electrons, each α — particle releasing about 90000 electrons before its velocity drops 60 per cent.

In this compound therefore, there is an action going on of α — particles of mass, positively charged with electricity and possessing great energy, releasing and coming in contact with other particles or electrons which are charged with a negative electricity. These electrons that have been bombarded out of the atoms become attached to adjacent molecules, and this means storing up the energy originally, derived from the α — particles. New and very complex unstable compounds are formed, the electrons of which want to rearrange themselves, and in so doing the charges of electricity combine instantaneously, producing light. This light therefore more or less originates in an electrical discharge, and in addition the compound passes through a very complex chemical change and rearrangement as a result. As the radium emits a very great number of α — particles, which in their turn release many times more electrons, a continual chemical change, rearrangement, and electrical discharge takes place resulting in a visible luminosity of the compound, the kinetic energy of the α — particles being absorbed in producing the electrons and in overcoming resistance.

It is quite evident from this, that although the radium to all intents and purposes is everlasting in emitting α — particles, there must be some limit to the number of electrons that can be released from the zinc sulphide present. In time therefore the number of electrons originally available will be halved and the luminosity will consequently be reduced one half, and so on, until the supply of the electrons from the zinc sulphide is exhausted and the luminosity dies away. The radium is still present in just as inexhaustible a state as ever and can be recovered. All radioactive compounds and paints containing radium, even if the luminosity is so reduced as to render them of little use, should not be destroyed.

To picture this exhaustion of the electrons from the crystals of the zinc sulphide, and the never failing bombardment of α — particles, consider an inexhaustible machine gun, so mounted that it can fire in any direction, continuously, and at any angle of elevation or depression. Consider the full range, in all planes through the gun, to be thickly studded with targets, assuming them on impact to be electrons released from the zinc sulphide, and the bullets to represent the α — particles. As the gun has an inexhaustible supply of ammunition and is being fired haphasard, in the course of time half the targets will have been hit, and in double that time half of the remainder will also be hit, and so on. Ultimately all the targets will have been hit, and although the gun can go on firing, assuming this ideal gun could exist, there would be nothing left for it to have effect upon in producing light, the heating effect remaining.

This picture defines, in the study of the production of luminosity in the radium compound, the effect of the α — particles from the radium in time exhausting all the effective electrons released from the zinc sulphide, the luminosity falling off in time and gradually ceasing to exist, but the α — particles still being projected from the radium atom with no effect.

The radioactive compound at present being used for the illumination of gun sights is made up in a dry powder, consisting chiefly of radium bromide and zinc sulphide and cemented in a small glass tube. The weight of radium bromide in this compound is usually 0·4 milligram to each gram of zinc sulphide used. Those who are already familiar with these tubes of radioactive compound will at once, I am sure, be surprised at the surprising luminosity obtained by the action of so small a quantity of this element radium.

The glass tubes containing this radioactive compound are only 0·34″ in length, 0·092″ in external diameter, and glass sealed at one end. The method of filling the tubes with the powder is interesting, and is done in the following way.

About twenty tubes are stuck, side by side, to a slip of sticking plaster, open ends in line and facing one way. The sealed ends are then dipped into a blue solution to test the sealing. If unsound the blue solution is drawn up into the tube by capillary action, giving a visible proof of the unsoundness of the end. These faulty tubes are removed from the strip, replaced by others, and the test again carried out until all the tubes are sound.

Twenty strips of these tubes are then placed in a thin perforated box made of nickel, with the open ends uppermost, the whole being weighed on an accurate balance. The compound in the form of a fine powder is poured on the top of the open ends of the tubes and the box shaken and tapped until the tubes are filled to the required height. The excess of the compound passes through the perforations in the box and can be caught in a suitable receptacle.

The box and tubes are again weighed and the amount of compound used is thus obtained by the difference in the two weighings.

When the tubes contain sufficient of the compound the open ends are sealed with cement and are ready for use.

2. Radium Paint.

Radium paint of this compound is made by mixing the powder with a little good mastic varnish. The best way of mixing is to pour a little of the powder into the middle of a watch glass and pour a few drops of turpentine to the bottom of the heap. The turpentine is drawn up through the powder and drives out any air. A few drops of the varnish are then added and the whole mixed with the brush to be used for the painting.

A metal knife or blade must not be used for mixing the paint, as this would damage the crystals and greatly reduce the luminosity. A fine sable brush must be used for applying the paint, and each coat must be thoroughly dried before adding the next. A final coat of varnish should then be given only as a protection, and the whole thoroughly dried.

It the paint is to be applied directly to silver, iron, or brass, a preliminary coating of zinc white should be given.

Before dealing with daylight paints, there are two very interesting effects of radium which I should like to mention.

(a). Excellent radiographs of coins or keys in a purse can be produced by taking a small quantity of Radium in a sealed glass tube, and supporting the tube for a certain time above a photographic plate with the purse laid on it.

(b). With a watch dial painted with radium paint at times a certain inconvenience may be created when dealing with photographic plates or films. The radium rays from the paint on the watch dial are capable of penetrating nontransparent materials, and therefore the plates or films in a package of undeveloped plates or films may be clouded or obscured by the proximity of such a watch.

Several experiments have been carried out to ascertain the degree of protection afforded to plates and films by pasteboard and by thin metal sheets, and it was found that a box of pasteboard afforded but slight protection, and that given by tin foil was exceedingly small.

The conclusion reached is that when wearing such a watch plates or films must be carried in boxes made of comparatively heavy metal, and on no account should a watch of this sort be worn in a dark room when very sensitive plates are being developed.

3. Daylight Paints.

This class of paint was first prepared by calcining crystals of sulphate of barium with organic matter, such as flour, and thus converting the sulphate into a sulphide, and was known as Bologna Phosphorus. Roasted oyster shell mixed with sulphur has also been used and is known as Canton's Phosphorus. This was greatly improved by addition of minute quantities of bismuth.

At the present time the best kinds of 'daylight' paints are made up with sulphide of zinc, sulphide of calcium, or sulphide of barium. The sulphides are mixed with a little good mastic varnish in a similar manner to radium paints, applied to the surfaces required in the same way, dried, and finally varnished.

With daylight paints the luminosity is not self contained as with radium paints and therefore have to be excited, or allowed to absorb energy, from an outside source which will be given out in the form of light in the dark.

The action of these paints in absorbing energy from daylight is analagous to that which goes on in radium compounds. Daylight, especially the blue rays, may be regarded as similar to that of the γ — radiation of radium only of a very low order. This radiation of daylight (analagous to γ — radiation) bombards electrons out of the crystals of the sulphides used, in a similar way as in radium compounds, creating a chemical change and rearrangement producing light.

In the dark this light is visible as a violet lavender coloured glow, but the luminosity gradually decays and falls off very rapidly after the first hour or two from the want of γ – radiation.

Daylight paints therefore are only of use where they can be continually exposed to daylight excitation previous to their being used at night.

I hope that this brief and elementary description, of what is really a very difficult and complex subject, will prove of interest generally. For those who appreciate the efforts of modern science in unravelling the mysteries of such wonderful discoveries as radium this article appeals, for not only a general interest, but a close study, combined with systematic and thorough research into the characteristics and properties of radium. Radium presents a wide field for research, and the revealing of its secrets will, I feel sure, make it possible for this radioactive element to be of the greatest use to both Naval and Military Services.

In preparing this article I am indebted to Mr. F. Harrison Glew for the great care and trouble he has taken in correction of the proofs and for many useful suggestions, also for the valuable information obtained from "Radioactive Transformations" by Rutherford, and "An Introduction to the Science of Radioactivity" by Raffety.

THE DIARY OF THE WAR OF 1914-15-16.

By COLONEL F. C. MORGAN, late R.A.

(Continued from page 172).

July 1st.

WESTERN EUROPE.—A great British attack was launched at 7.30 a.m. North of the River Somme, in conjunction with the French: our troops broke into the German forward system of defences, on a front of 16 miles.

Heavy fighting continued throughout the whole of the day, between the rivers Ancre and Somme, and also North of the former, as far as Gommécourt inclusive: on the right of the attack the German labyrinth of trenches on a front of 7 miles and a depth of 1000 yards was captured, and the fortified villages of Montauban and Mametz, East of Fricourt and Albert, were stormed and taken. The fighting North of the Ancre was of a violent character, and some portions of the trenches could not be retained, by our troops. In the vicinity of Fricourt, the German casualties were severe, and 2000 were taken prisoners. Elsewhere between Souchez and Ypres our raiding parties penetrated the enemy's trenches.

A considerable amount of successful air work was done during the day.

The French communiqué states that North and South of the river Somme, the Franco-British troops developed this morning an offensive action on a front of about 25 miles, and along the whole line of the attack, the allied troops captured the 1st line German positions.

South of the Somme the villages of Dompierre, Becquincourt, Bussu and Fay fell into French hands, and also unwounded prisoners to the number of 3,500. French airmen carried out successful reconnaissance and bombing raids.

On the night of the 30/1st July in the Verdun area the Germans made furious attacks on the positions of Hill 304 and Avocourt redoubt, delivering four assaults, in which they were temporarily successful at various points: at the Thiaumont work now a heap of ruins, they also gained the position, only to be once more driven back.

July 2nd.

WESTERN EUROPE.—To-day at 2 p.m. Fricourt was captured by our troops, and the prisoners taken now amount to 3,500, together with a considerable quantity of war material.

At La Boiselle, the enemy offered a stubborn resistance throughout the day: the country about the Somme in Picardy, where the

fighting is taking place, is open and slightly undulating, and in the present tactics, the artillery plays a leading rôle.

On the French front North of the Somme, the fighting during last night was of a fierce nature: about Hardecourt the enemy's counter-attacks were all driven back. The village of Curlu on the Somme was taken; and South of the Somme, during the night progress was made between Herbécourt and Assevillers: 5000 unwounded prisoners were captured.

RUSSIAN FRONT.—Having captured Kolomea, the Russians are advancing on Stanislau, and threatening to outflank the Austrian centre.

July 3rd.

WESTERN EUROPE.—All the positions gained by our troops have been maintained, and the battle South of the river Ancre, continues to be hotly contested.

The fighting about La Boiselle (N.W. of Fricourt) and Ovillers North of the former, has been particularly severe, and at Ovillers met with varying success: in the afternoon the fight between La Boiselle and South of Thiepval fluctuated, the advantage on the whole remaining to our side.

The amount of captured armament and stores was very considerable, and the enemy prisoners taken amount to over 4,300.

On the remainder of the front, except for heavy hostile artillery fire at certain places, no incident of importance occurred.

A very large number of air combats have taken place, and eleven of the enemy's machines have been brought down; since the commencement of the present battle fifteen British airplanes have been lost.

On the French front North of the Somme, the positions gained were organised, and no counter-attacks were made by the enemy during the night, but South of the river, the struggle continued.

Two lines of trenches in the German 2nd positions on a front of about 3¼ miles, from the Bois de Méréaucourt (E. of Frise) to Assevillers, have been completely occupied, together with the fortified village of Herbécourt lying between: further South to Estrées substantial progress was made. The French airmen's work has been throughout particularly effective.

On the Verdun front, after a violent bombardment, the Damloup work was lost to the French, but was afterwards retaken.

July 4th.

WESTERN EUROPE.—On the British front, the enemy reinforced by many battalions, stubbornly resisted our troops at all points in the Somme area, and during the night after heavy fighting, a small portion of our positions South of La Boiselle were recaptured from us, but later, the whole village was in our possession: further South, progress was made, and our troops gained a wood, and more prisoners and war material. Amongst several raids carried out on other parts of our front, a specially successful one was made by the

Rifle Brigade and Sherwood Foresters: a raid on the part of the enemy near Armentierès was repulsed.

Railway centres at Comines, Combles and St. Quentin were successfully attacked by aircraft, and seven German machines were driven down.

On the French front, North and South of the Somme, during the night, the enemy attempted no counter-measures against the troops, who are organised on the positions they captured.

During the day the positions of our ally were extended South and East, and Estrées was occupied; 500 more prisoners were taken.

On the right bank of the Meuse, the Germans for the 4th time captured the Thiaumont work.

RUSSIAN FRONT.—On Hindenburg's front, near Baranovitchi, two lines of German defences were broken through, and 4000 made prisoners.

ITALY.—As the result of intense fighting in the past few days, Italian troops have occupied further advanced posts in the Posina and Asiago sectors.

ARABIA.—A despatch from the C.-in-C. India dated 9th March 1916, recounts certain operations that have taken place in the vicinity of Aden.

The despatch states that on the outbreak of war with Turkey on 31st Oct., 1914, the Turks were collected in some strength in the Shaik Said peninsula, at the S.W. point of Arabia, and at the entrance to the Red Sea, they having in view an attack on the Aden protectorate.

The 29th Indian Brigade en route to Suez were directed to effect a landing under cover of the guns of H.M.S. "Duke of Edinburgh," this resulted in the enemy being driven inland, when the force re-embarked: later the place was reoccupied by the enemy, and on the 14/15th June they made an unsuccessful attempt to land on the Island of Perim, two miles distant.

In July 1915, a moveable column was sent out from Aden against a Turkish force threatening Lahaj, 23 miles inland, but owing to adverse conditions prevailing, after engaging the enemy, a withdrawal to Khor Maksar was necessitated on the following day: Major General Shaw in command of the force "pays a tribute to "the devotion to duty of the men of the Royal Artillery, who effected "the withdrawal of their guns under the most trying conditions": other minor engagements followed, which resulted in the Turkish pressure on the Arab tribes being relieved.

July 5th.

WESTERN EUROPE. British Front.—Throughout the night, heavy fighting continued between the Ancre and the Somme, and Sir Douglas Haig reports that further progress has been made at "certain important points"; but the enemy are still offering vigorous resistance, and especially on the Thiepval plateau: the fighting all along the battle front consists chiefly of local struggles for the capture of positions. The prisoners taken in the last 5 days number 6000. On the remainder of the front there was the ordinary trench warfare.

French Front.—During the night, General Foch's troops captured a line of trenches N.E. of Curlu and also a farm opposite Clery, 3 miles N.W. of Peronne, after an intense bombardment. The Germans still hold out at Estrées further South. The number of unwounded prisoners taken by the French exceeds 9,000. The whole German 2nd position to the South of the Somme is now in our ally's possession on a front of about 6¼ miles.

The French cavalry have been doing patrol work during the last few days, along the whole line West of Peronne. About Verdun, the Hill 304 and Avocourt were unsuccessfully attacked by the Germans.

RUSSIAN FRONT.—General Evert's offensive, on a front of 25 miles, near Baranovitchi is meeting with a desperate resistance.

July 6th.

WESTERN EUROPE. British Front.—A further slight advance was made near Thiepval, and prisoners were captured from the enemy. South of La Bassée Canal, successful raids were made into the German front line, in one of which, the Royal Welsh Fusiliers took 43 prisoners and destroyed 3 mine shafts, the enemy suffering 150 casualties. In other parts the situation remains unchanged.

French Front.—North of the Somme local engagements occurred, and North of the village of Hem in French occupation, the enemy took two small woods. South of the river, German attacks between Estrées and Belloy (S.W. of Peronne) were stopped by curtain fire.

On the left bank of the Meuse, both artilleries were active in the Chattancourt sector, and on the right bank the enemy violently bombarded Fumin wood, and the Damloup battery.

RUSSIAN FRONT.—On nearly every part of the front successful operations are reported, and over 10,000 more prisoners have been captured from the enemy.

NAVAL.—The dispatch from Admiral Sir John Jellicoe G.C.B., &c., C.-in-C. Grand Fleet, respecting the action in the North Sea on the 31st May, 1916, is published to-day.

July 7th.

WESTERN EUROPE. British Front.—A continuous great battle was fought during the day between the Ancre and the Somme, when in spite of bad weather and stubborn resistance, our troops in commencing the 2nd stage of their advance, made several important gains.

East of La Boiselle, following on successes during the night our troops advanced over a maze of German trenches, on a front of nearly 2000 yards and a depth of 500. S.W. of Thiepval an attack on our new lines was crushed, and later the Leipzig Redoubt, South of that place was carried by assault.

East of Contalmaison, the Prussian Guard endeavoured unsuccessfully to force back our advance, and the enemy fell back Northwards, leaving 700 prisoners in our hands: at noon the village

of Contalmaison was taken by storm, but was retaken later by a counter-attack of the enemy.

The village of Bazentin-le-Petit (4½ miles East of La Boiselle) was heavily shelled, when observed to be full of German reserves.

FRENCH FRONT.—The communiqué states that the night was calm, and nothing of importance occurred during the day on either bank of the Somme.

On the Verdun front there was no change in the line, as the result of persistent German attacks.

RUSSIAN FRONT.—The Russian offensive is now chiefly exerted in the section of the fighting line, extending from the lakes North-East of Vilna to the railway junction of Baranovitchi, north of the Pripet marshes; any further advance in Volhynia and Galicia being of less importance, now that the pressure on the Italians in the Trentino has been relieved.

North of the Lutsk salient, along the course of the river Styr, the German line has been broken, and cavalry have been sent in pursuit of the enemy; several villages have been captured, and the Russians have advanced their whole front in this region; the enemy lost in this battle 8000 prisoners.

MESOPOTAMIA.—Sir Percy Lake reports the general position unchanged, both on the Tigris and Euphrates line, but climatic conditions were particularly trying.

July 8th.

WESTERN EUROPE. British Front.—The night of 7/8th was chiefly spent in improving the forward positions gained in yesterday's operations. During the day, the fighting was principally on our right flank, where important successes were obtained. East of Montauban, a line of trenches was stormed, and a lodgment gained in the Bois des Trônes, when 130 prisoners and machine guns were captured; the French on our right greatly assisting.

In the neighbourhood of Ovillers, hand to hand fighting continued amongst the ruins of the village and further progress was made.

Despite cloudy weather our airplanes and kite planes did useful work.

FRENCH FRONT.—On the Somme front bad weather hindered operations, but in the vicinity of Belloy-en-Santerre (5 miles S.W. of Peronne) a successful coup-de-main was carried out, when 350 prisoners were taken.

North of the Somme French troops assaulted and took the village of Hardecourt (2 miles S.E. of Montauban) in conjunction with British troops on their left, who were assaulting positions in the Bois des Trônes at the same time.

RUSSIAN FRONT.—The Russian offensive East of Kovel has driven back the enemy 25 miles in some places, and in four days operations, 12,000 prisoners have been taken on the 50 mile front from the Pripet river to the Lutsk salient: our ally has now reached and crossed the Stokhod river at a distance of 22 miles from Kovel. Further South Lechitsky's troops, have advanced 50 to 60 miles and have taken Delatyn, a railway and road junction, at the foot of the

Carpathians, linking Hungary with the enemy's front in Galicia.

On the Caucasian front, Turkish attacks at Platana 9 miles West of Trebizond have been repulsed.

July 9th.

WESTERN EUROPE. British Front.—On the night of the 8/9th, the fighting between the Ancre and the Somme was considerably less violent than during the last two days. By day, artillery duels took place in several sectors of the battle front.

Further progress was made in the neighbourhood of Ovillers, and the enemy launched two violent but fruitless attacks on our new positions in or near Trônes wood.

Near Givenchy, north of La Bassée Canal three mines were successfully sprung; still further North, at a portion of the sector held by New Zealand troops, our trenches were entered at one point, from which the enemy were soon ejected.

FRENCH FRONT.—On both sides of the Somme, the night was quiet: to the South of the river, the enemy's positions East of Flaucourt on a front of 2½ miles were carried, including the villages of Biache, one mile West of Peronne and Barleux, when 300 prisoners were taken.

AIRCRAFT.—At 10.45 a.m. a hostile airplane crossed the Kent coast near the N. Foreland, and flew a short distance westward; no bombs were dropped, and the enemy was driven to sea by our anti-aircraft guns and airplanes.

July 10th.

WESTERN EUROPE. British Front.—During the past 24 hours, particularly severe fighting has centred round Trônes Wood, which extends 1400 yards from N. to S. and is strongly fortified; its southern end was captured on the 8th, and subsequently German counter-attacks of a violent nature were crushed with serious casualties to the enemy; on the 10th the enemy succeeded in entering the wood and the fighting continues. Further to the West ground was gained in the Bois de Mametz and to the East of Ovillers and at La Boiselle.

The Royal Flying Corps carried out successful bombing attacks against various detraining centres, ammunition depôts and aerodromes, when numerous air combats were fought.

FRENCH FRONT.—The past night and to-day passed off quietly on the North of the Somme, and South of the river, the French troops captured a line of German trenches in the region of Barleux (3 miles N. of Peronne) taking 950 prisoners. Later in the day progress was made between Biaches and Barleux, and Hill 97 dominating the river was occupied.

French airmen made successful raids on stations at Ham and Bolancourt.

RUSSIAN FRONT.—The Russians are pursuing the enemy along the Sarny—Kovel railway; and in addition to the prisoners taken on the Kolki front, Kaledin's army to the South took 9000

between the 4th and 8th of July: in five days 34,000 of the enemy have been captured, including those in Galicia.

On the whole front between the Stokhod and Styr rivers, the Russians are going forward.

GERMAN EAST AFRICA.—General Smuts reports the capture of Tanga, the sea-terminus of the railway from Usumbara: a previous attempt to take the place was made in November 1914 which failed, the Indian troops having been compelled to re-embark and return to Mombasa in Br. E. Africa.

MISCELLANEOUS.—A German submarine the "Deutschland" arrived at Norfolk, Virginia, U.S.A., the boat is stated to be unarmed and to be carrying passengers and 1000 tons of cargo.

July 11th.

WESTERN EUROPE. British Front.—On the night of the 10/11th our infantry for a 2nd time carried Contalmaison by assault, taking 189 unwounded prisoners; a strong counter-attack was afterwards repulsed. The greater part of the wood of Mametz was also stormed and taken, together with one heavy Howitzer, three field guns, and 296 unwounded prisoners. To-day nearly the whole of the Trônes wood except the northern portion is in our hands.

Sir Douglas Haig further reports that after ten days and nights of continuous fighting, our troops have captured the whole of the enemy's 1st system of defence on a front of 14,000 yards, consisting of numerous and continuous lines of fire trenches and reserve trenches extending to various depths of 2 to 4000 yards; also of five strongly fortified villages, numerous wired and entrenched woods, and a large number of very strong Redoubts; in addition 26 field guns, a heavy howitzer, and an anti-aircraft gun have been brought in, and 7,500 German prisoners captured.

FRENCH FRONT.—Both last night and during the day, relative quiet is reported on the Somme. In the Verdun area, a German infantry attack was made from Fleury to Chenois, following on an all night bombardment, when a footing was gained temporarily in the French advanced trench. In other parts, minor attacks were made, and at Reillon in Lorraine, the enemy gained and were able to hold a short length of trench forming a salient.

RUSSIAN FRONT.—On the river Stokhod, the Germans are making a stand, having brought up reinforcements and powerful artillery to defend the passages of the river. The Russians are still fighting for the crossings; the previous reports as to their having crossed, have proved to be erroneous. General Brusiloff's estimate of prisoners and booty captured during operations against the Austro-German armies up to July 10th is as follows: 5,620 officers, 266,000 men, 312 guns and 866 machine guns.

July 12th.

WESTERN EUROPE. British Front.—During the night the Germans regained some ground in Mametz Wood and Trônes Wood, which however was recovered during the day. At other points in the new positions, strong hostile attacks were driven back.

South-East of Loos and opposite Hohenzollern, parties of the Royal Irish Fusiliers and Seaforth Highlanders respectively penetrated the enemy's trenches.

Two heavy attacks against Contalmaison completely broke down under our fire.

FRENCH FRONT.—The communiqué states that on both sides of the Somme the night passed quietly, and during the day there was nothing to report.

At other parts of the French line, there was much activity, especially about Verdun, where some ground in Fumin Wood was regained by our ally.

A formidable attack was made by the enemy on Fort Souville by six regiments amounting to some 20,000 men, on a front of 3000 yards from Fleury to the Vaux-Chapitre Wood; at the cost of enormous losses they succeeded in gaining some ground.

RUSSIAN FRONT.—Violent fighting continued on the Stokhod, the barrier on the roads to Kovel. West of Erzrum, more prisoners have been captured and Turkish positions carried.

NAVAL.—On the night of the 11th a German submarine appeared a few hundred yards off Seaham Harbour on the Durham coast, and fired 30 rounds of 3-inch Shrapnel, which caused the death of one person and struck a house.

In the Adriatic, on the 9th, 4 British drifters on patrol were surprised by an Austrian cruiser, when two were sunk, the remainder returning to port damaged.

July 13th.

WESTERN EUROPE. British Front.—The artillery of both sides are reported to have been active throughout the day, and sharp infantry fighting has appreciably advanced our line at various points on the front: in one sector some German howitzers with a quantity of ammunition were captured, to be used at a suitable opportunity.

South of Ypres and also South of La Bassée Canal, the enemy attempted a raid on our trenches, but were driven off.

FRENCH FRONT.—There was an intermittent cannonade on the Somme front, but nothing of importance to report.

On the right bank of the Meuse, there was a lively bombardment in the Souville sector.

RUSSIAN FRONT.—General Brusiloff's army is now stationary on the Lutsk salient and at Baranovitchi: across the Stokhod artillery duels are proceeding preparatory to new developments. In Galicia, the positions are unchanged, but ten miles West of the Strypa, the Russians have taken 2,000 prisoners.

In Armenia, the Grand Duke Nicolas, is making for the military centre of Erzingan.

MESOPOTAMIA.—On the Tigris our troops facing the Sanna-i-Yat defences, were on the 9th to 12th bombarded ineffectually by artillery and machine gun fire and also by aircraft. The shade temperature is reported as 117° Fahr.

July 14th.

WESTERN EUROPE. British Front.—The German's 2nd

system of defence was attacked at dawn to-day, and our troops broke into the hostile positions, on a front of 4 miles, and captured several strongly defended localities.

The assault was launched at 3.25 a.m., after an intensive bombardment, and the enemy was driven from his trenches on the whole front attacked, many prisoners being captured. Fighting continued throughout the day, and the enemy's 2nd position from Bazentin-le-Petit to Longueval village and the whole of the Trônes Wood remained in our possession. A party of the Rl. W. Kent Regiment was relieved after having been cut off and surrounded in the Trônes Wood by the Germans.

FRENCH FRONT.—Nothing of importance was announced from the French front.

RUSSIAN FRONT.—Since the Russian offensive drove back Von Hindenberg's forces on the Vilna—Baranovitchi front, the latter have been able for the time to stay the advance of our ally: Petrograd reports no change on the whole line.

On the Caucasus front, to the West of Erzrum, the Russian offensive is developing successfully.

July 15th.

WESTERN EUROPE. British Front.—All continued to go well on our front, and at a point between Fricourt and Mametz the Germans have been forced back 4 miles, to their 3rd system of defence: in the past 24 hours, 2000 prisoners have been captured, bringing the number taken by the British since the battle began to 10,000.

In the Pozières—Guillemont sector of the German 2nd line of defence, heavy fighting continues; and Eastward of Longueval, the whole of Delville Wood has been taken.

North of Bazentin-le-grand, our troops have penetrated the German 3rd line at the Bois de Fourreaux (High Wood), and in this neighbourhood, a detachment of the enemy were successfully accounted for by a squadron of Dragoon Guards, that being the first occasion on which cavalry have been employed as such, since 1914, and our troops have fought their way to the outskirts of Pozières.

During the last 24 hours 3 Fokker machines, 3 biplanes and a double engined airplane, have been destroyed in air combats; all our machines engaged returning safely to our lines.

FRENCH FRONT.—In the region South of the Somme the Germans attacked La Maisonette and the village of Biaches (one mile West of Peronne) which they captured; both were however retaken by vigorous counter-attacks.

RUSSIAN FRONT.—In Volhynia, on the Southern face of the Lutsk Salient, a violent battle ensued, in which the Russians claim to have defeated and put the enemy to flight, besides capturing guns and 3000 prisoners.

July 16th.

WESTERN EUROPE. British Front.—With the exception of heavy bombardments by both sides, no event of importance has

occurred, since the last report.

Five more heavy howitzers and four 11 m.m. guns have fallen into our hands, and also a large quantity of armament and other war material, abandoned by the enemy in the positions captured on the 14th and 15th.

The troops were engaged at night, in strengthening and improving our new positions, covered by a detachment which had been thrust forward in the Bois de Fourreaux, this detachment was afterwards withdrawn into the main line.

FRENCH FRONT.—During the last two days, the French have gained somewhat, in their positions around Fleury, 3 miles from Verdun, and at Hill 304 on the West of the Meuse, have improved the situation. On the Champagne front, the Russian patrols have done some good work.

CAUCASUS.—The Russian troops captured Baibert, on the Erzrum—Trebizond road, an important centre in the Armenian theatre of war: they have also been successful in a series of engagements in the regions about Mamakhatun and Mush 60 miles South of Erzrum.

July 17th.

WESTERN EUROPE. British Front.—Further important successes have been recently gained by our troops. On a front of 1500 yards, North-West of Bazentin-le-Petit Wood, German 2nd line positions were stormed and taken.

East of Longueval, Waterlot Farm has been captured, and the village of Ovillers-la-Boiselle is now in our hands.

In the evening it was reported that incessant rains have interfered with operations and nothing of importance occurred during the day.

Since July 1st, unwounded German prisoners taken amount to 189 officers and 10,779 other ranks: whilst the captured armament collected up to date now includes, 5, 8-inch and 3, 6-inch howitzers, 4, 6-inch and 5 other heavy guns, 37 field guns, 30 trench howitzers, 66, machine guns, and also many thousands of rounds of ammunition.

FRENCH FRONT.—Near Fleury in the Verdun sector the French report some progress made; and in Champagne, a German coup-de-main against a trench held by Russian troops failed. The weather was reported bad.

Since the opening of the Somme offensive, the French have captured 235 officers, 11,741 other ranks, 85 guns, 89 machine guns and other booty.

RUSSIAN FRONT.—Further details of the recent fighting in Vothynia, show that General Brusiloff's troops won a victory on a front of 12 miles, on the S.W. side of the Lutsk area, 17 miles from Lutsk: the enemy were driven back some 7 miles and sought refuge behind the river Lipa a tributary of the Styr: the prisoners taken in the fighting in this region amount to 13,000 together with 30 guns, including 17 heavy pieces.

ITALY.—On the South-Eastern Trentino border, heavy

Austrian attacks on the Italian advance, have been successfully repulsed.

July 18th.

WESTERN EUROPE.—In the region of the Somme, bad weather still interfered with the operations on the British front, but to the North of Ovillers our troops made substantial progress last night on a front of 1000 yards.

Near Wytschaete a successful raid was made into the German trenches, and opposite Cuinchy an enemy's raid was frustrated by our fire.

In the evening an attack on our front was commenced near Longueval and the Delville Wood, and the fighting continued.

South of the Somme, French positions between Biaches and La Maisonette were attacked during the night, but the enemy were unable to obtain possession of the latter village.

During the day there was comparative calm everywhere on the French front.

July 19th.

WESTERN EUROPE. British Front.—After an intense artillery fire, the German attack which commenced at 5.30 p.m. on the 18th, was continued throughout the night, and in a portion of Delville Wood and in the Northern outskirts of Longueval the enemy obtained a footing, but three separate assaults on Waterlot Farm, broke down completely under our fire. During the day most of the ground lost was regained, and a large body of Germans massing to again attack Waterlot Farm were dispersed.

FRENCH FRONT.—South of the Somme, the French seized some of the enemy's trenches and took prisoners: in the Verdun area progress is reported.

GERMAN EAST AFRICA.—The principal German port Mwanza on Lake Victoria Nyanza was occupied on the night of 14/15th by a British force: many Germans escaped in a steamer and were pursued by armed lake vessels.

In the Usumbara district, the clearance of the enemy is progressing satisfactorily.

MISCELLANEOUS.—Sir Victor Horsley, whilst serving as a consultant with the British forces in Mesopotamia, died on July 16th.

July 20th.

WESTERN EUROPE. British Front.—The struggle in the Delville Wood and Longueval areas continued and some more ground there has been gained: to the North of our Bazentin—Longueval position, our line has been pushed forward about 1000 yards and prisoners captured: also South of Thiepval our bombing parties made a substantial advance: elsewhere in the main battle area, there was chiefly artillery fire, except South of Armentières, where our troops including Australians, carried out important raids, on a front of two miles and captured 140 prisoners.

Successful bombing enterprises are reported to have taken place on the 19th on the part of our aircraft, when many tons of explosives were dropped on important points: one hostile machine was destroyed and several others damaged and forced to the ground: since the 16th four of our machines have failed to return to our lines.

FRENCH FRONT.—On the Somme, the French infantry attacked the German positions with great success. On the North bank the enemy's trenches from Hardecourt Hill to the river were carried, and the line extended an appreciable distance East of Hardecourt, along the narrow-gauge railway running from Combles to Clery.

South of the river between Barleux and Soyécourt all the enemy's 1st line trenches were taken. Later in the day the positions taken were consolidated and an attack carried in its entirety the 1st German positions from Estrées to the Hill of Vermand Ovillers, S.W. of Estrées.

In the day's fighting, 2900 German prisoners were taken, including 30 officers, besides guns and war material. Before Verdun, the enemy was driven back West of Thiaumont, and South of Fleury a strong work was captured.

MISCELLANEOUS.—It was announced by the Prime Minister that a Government enquiry was to be made, into the operations in Mesopotamia and at the Dardanelles. It was also announced in Parliament that 136 German Naval officers and 2,056 men were prisoners of war: and 45 British Naval officers and 364 men prisoners in the hands of the enemy.

July 21st.

WESTERN EUROPE. British Front.—South of Thiepval and in the Delville Wood North of Longueval, the battle has continued without intermission, and the British advance on the Bazentin—Longueval line, has been pushed as far as the Bois des Fourreaux (High Wood), 2 miles East of Pozières, from which the enemy was driven: during the night of the 20/21st, their counter-attack, after an intense bombardment with gas shells, succeeded in effecting an entry into the Northern end only of the High Wood. There has been a lull in the main battle area throughout the day.

Fair weather enabled the Rl. Flying Corps to continue bombing operations against points of military importance with good results: there were also many air combats towards the evening, in which 5 German airplanes were either shot or driven down, one British machine only being lost, but two were missing.

FRENCH FRONT.—On the 20th at the close of the day, the enemy delivered a counter-attack against the new French positions South of Soyécourt, but the night was quiet on both sides of the Somme and during this day there was nothing in this area to record.

On the Verdun front, there was great artillery activity on both sides at Chattancourt and Fleury; and between Soissons and Reims an enemy's trench near Vendresse was penetrated.

French air squadrons successfully bombarded several railway stations behind the German lines.

RUSSIAN FRONT.—The troops under General Sakharoff have again inflicted a heavy defeat on the Austrians at the junction of the Lipa and Styr rivers, South of the Lutsk salient. In the Caucasus the Russians are advancing along the Erzrum—Trebizond road, and have captured another town 100 miles from Erzrum.

MISCELLANEOUS.—Despatches from Lord French and General Maxwell on the rising in Ireland are published.

July 22nd.

WESTERN EUROPE. British Front.—The artillery on both sides have been more active, and the British line and support trenches have been heavily bombarded with gas and tear shells: nothing else of importance occurred.

French air squadrons dropped 115 large bombs on the railway station and track at Metz—Sablons, doing considerable damage.

RUSSIAN FRONT.—In the Riga district after continuous bombardments, infantry attacks have developed, and at several points, the Russians have penetrated the German 1st line.

EGYPT.—The War Office report that a Turkish force has advanced from El Arish to 5 miles East of Katia and entrenched: our mounted troops are in contact with the enemy. Hostile aircraft attacked Suez on the 21st causing a few casualties.

July 23rd.

WESTERN EUROPE. British Front.—The battle along the front from Pozières to Guillemont, was resumed with great violence. In the neighbourhood of Pozières, territorial and Australian troops carried the German outer works by assault shortly after midnight of the 22/23rd, and fighting there continued throughout the day.

Longueval was at one period during the day captured, but was once more regained by the enemy; and the outskirts of Guillemont changed hands twice.

On the French front on the Somme, there were artillery duels; and South of Soyécourt a German night attack on the 22/23rd on the French new positions failed.

July 24th.

WESTERN EUROPE. British Front.—A quiet night followed yesterday's severe fighting, except for continuous heavy shelling.

During the day, fighting continued in the Pozières village, but between the Ancre river and the sea nothing of importance occurred.

The night was also quiet on the French front, and the weather is reported bad.

South of the Somme, a German battery was captured south of the village of Estrées.

Since the 20th July, the French have taken 60 German machine guns. In the fighting about Fleury, 3 miles from Verdun, during the last 10 days, the enemy's positions have been encroached upon by our ally, and 800 prisoners captured.

NAVAL.—At midnight on the 22nd, near the North Hinder Light vessel, three enemy destroyers were sighted by some of our light craft, and subsequently off the Schonwen bank, six German destroyers were engaged; during a running fight they were frequently hit, but were able to reach the Belgian coast; our only casualties were one officer and one man wounded.

July 25th.

WESTERN EUROPE. British Front.—Sir Douglas Haig reports that further reinforcements of infantry and guns, have been brought to the Somme front by the enemy. On the 24th the hostile bombardment was reported as heavy, and an attempt to attack our right flank was frustrated, also two infantry attacks on our centre during the night of 24/25th were stopped: the enemy's casualties in these fruitless attacks were severe.

Opposite the North of Pozières our troops are encountering strong opposition, and to-day an unsuccessful attack was made on the village by the enemy: there has also been fierce hand to hand and bomb-fighting at various places on the battle front.

South of the Somme, a group of fortified houses South of Estrées, were carried by the French, who also drove the Germans from some trenches North of Vermand—Ovillers.

RUSSIAN FRONT.—The troops under General Sakharoff have for a third time in 10 days, attacked in force the Austrian position East of the Styr, about 12 miles from Brody on the line from Dubno to Lemberg, and have penetrated the enemy's advanced lines: during the battle still in progress, 1000 prisoners have been already captured.

In Armenia the Russians are closing in on Erzingan, behind the retreating Turks.

ITALY.—On the Asiago plateau the Italian advance continues, and further South the position on Monte Cimone guarding the town of Arsiero was taken in a night attack.

NAVAL.—A despatch from V. Admiral Bacon, Commanding the Dover Patrol is published, describing the operations of this naval force, since December 1915, which he states included the protection of merchant ships, and of the flanks of all the sea transports to and from our army in France, as well as offensive work carried out by sea and air. Over 21,000 merchant vessels passed through the patrol in the past 6 months, and the losses amongst this number have been less than one per thousand: in accomplishing the above duties 4% of our Patrol vessels have been sunk, and 77 officers and men have lost their lives.

July 26th.

WESTERN EUROPE.—On the British front Pozières is now reported to be in our hands; and to the West of the village Territorial troops captured two strong trenches and a number of prisoners including five officers: elsewhere there was no change on the battle front, and with the exception of artillery duels and local encounters, no incident of importance occurred to-day.

The night was quiet for the French on the Somme front: 117 prisoners and four 105 m.m. guns were brought in yesterday: to-day led to no important occurrence on the French front.

RUSSIAN FRONT.—The third battle of Sakharoff's army is developing and the prisoners taken now amount to 4,000, with six guns.

The Caucasus army has captured the military station of Erzingan, an advanced base for the Turks, and the conquest of Armenia is stated to be complete.

July 27th.

WESTERN EUROPE.—During last night our artillery was active, and hand to hand encounters also took place at various points: North of the line Pozières—Bazentin-le-Petit two hundred yards of an important German trench were captured, but a portion was afterwards retaken by the enemy.

To-day there was heavy fighting in Delville Wood, where our troops gained the East and North-East portion, also at Longueval, a part of which is still held by the enemy. To the West of the Ypres—Pilkem road, our trenches were entered temporarily only, and further South our infantry raided some German trenches after an artillery preparation.

On a front of over 9000 yards, our troops are now established in the German 2nd lines, and since the opening of the Somme battle on July 1st we have captured 24 square miles of the enemy's ground.

RUSSIAN FRONT.—On the Northern and central fronts, the fighting is of a desultory nature at present: in Galicia, the Russians continue their advance on Brody and the railway line to Lemberg.

PERSIAN GULF.—A despatch from General Sir John Nixon commanding Indian Expeditionary Force "D" dated 15 Jan. 1916, is published to-day, relative to operations at Bushire in the Persian Gulf, and Dilwar in the vicinity, between July and September 1915.

It mentions the seizure and occupation of Bushire on Aug. 8th, 1915, and also of the fortified village of Dilwar on Aug. 13th, and the defeat of the enemy at Bushire on Sept. 9th.

In July the Tangistan coast tribesmen made an unprovoked attack on a British detachment at Bushire, it was accordingly resolved to seize and occupy the port, which was done without opposition on August 8th.

Further as a punitive measure, a mixed naval and military force was landed at Dilwar, a fortified village and the headquarters of the tribe: the landing met with opposition, but the guns of a naval squadron finally drove the enemy inland: fighting also took place on the 14th and 15th Aug.; and after the port and village had been destroyed the forces re-embarked.

On Sept. 9th, it having been ascertained that the enemy were preparing an attack on the island of Bushire, across the Mashileh peninsula, joining it to the main land, a force was sent out from Bushire, which attacked and scattered the tribesmen, who were shelled also by the naval guns, and their defeat completed by an Indian cavalry regiment.

July 28th.

WESTERN EUROPE.—On the British front, the troops after severe fighting, have driven the 5th Brandenburg Division, from their remaining positions in Delville Wood, capturing 3 officers and 158 men; the whole of the Wood is now in our hands, two heavy counter-attacks having been driven off.

Further progress was made in Longueval, and later, the last stronghold in the village was captured. In the vicinity of Pozières there was hand to hand fighting throughout the day. Elsewhere on the battle front there was considerable artillery activity on both sides.

On the French front in Champagne, a reconnaissance made by Russian troops, penetrated an enemy's trench and brought back prisoners.

On the right bank of the Meuse a German attack about to debouch on French positions West of Thiaumont Work was stopped by artillery fire. French air squadrons have been actively engaged in air combats, and in bombarding German positions of importance behind their lines.

RUSSIAN FRONT.—The three victories won in Volhynia by General Sakharoff have resulted in the capture of Brody, which should compel the Austrians to fall back from the line of the Strypa river.

To the West of Lutsk, the Russian offensive has broken through the 1st line of the enemy, who fled before the troops advancing with cavalry; in this district 46 guns, including 6 howitzers and 9000 prisoners were captured.

BALKANS.—The reconstituted Serbian army have been for some days in contact with the Bulgarians, and have captured a series of heights, 6 miles within the frontier, which had been previously seized and fortified by the enemy: the Bulgarians in counter-attacking were driven back with great losses.

MESOPOTAMIA.—General Lake reports that two British gun-boats were fired upon from both banks of the Euphrates River, 40 miles up-stream from Nasir-i-yeh; the gun-boats replied and inflicted several casualties; one British naval officer and five men were wounded.

AIRCRAFT.—A German seaplane was destroyed at sea ten miles off Ostend, by a British airplane on July 15th.

July 29th.

WESTERN EUROPE.—On the British front two more attacks on Delville Wood were repulsed, and the struggle in the vicinity of Pozières and in the neighbourhood of High Wood continued without intermission, during the night.

To-day nothing of importance occurred except minor local actions and heavy artillery fire: on the 28th three enemy airplanes were destroyed and a kite balloon was seen to fall in flames.

On the French front on the Somme, two attacks by the enemy West of Vermand-Ovillers were repulsed.

RUSSIAN FRONT.—At the occupation of Brody after three day's fighting, 400 officers and 20,000 prisoners were captured by the Russians.

Kaledin's troops have now forced the passage of the Stokhod river, at a point 21 miles from Kovel, and threaten the whole German defensive plan, and further South Kaledin has advanced his line towards Vladimir Volynsk: the enemy's front is reported as broken on a line 13 miles in length. South of the Dneister, the Austrians have been thrown back in the direction of Stanislau by Lechitsky's troops.

July 30th.

WESTERN EUROPE.—On the night of the 29/30th the enemy's trenches between the Ancre and the Somme, were heavily shelled by our artillery, which also exploded an ammunition depôt North East of Thiepval: South of Ypres Canadian troops made successful raids, similar enterprises being carried out in the Loos Salient by the Rl. Munster Fusiliers. Near the Hohenzollern Redoubt two raids were made by the enemy who in one case entered our trenches but for a short time only.

An advance in conjunction with the French took place on 29/30th on a front extending from the East of Delville Wood to the Somme, when 250 prisoners were captured. During the day, the ground gained in the past week was strengthened, and there was no infantry fighting. Three hostile airplanes were destroyed yesterday and others were forced down in a damaged condition.

EGYPT.—Several patrol engagements are reported to have taken place, with the enemy on July 28th, in one of which New Zealand Mounted Rifles caused them 50 casualties; our losses were very slight.

AIRCRAFT.—A raid by three German airships on the East coast of England was made between midnight and 1.30 a.m. on July 29th: 32 bombs were dropped in Lincolnshire and Norfolk but no material damage was done.

July 31st.

WESTERN EUROPE.—On the British front, the night of the 30/31st was spent in improving positions gained yesterday, and as a result of local encounters, our posts were advanced at some points on the plateau North of Bazentin-le-Petit.

No incident of importance occurred during the day. The Royal Flying Corps have carried out several bombing raids and have dropped seven tons of bombs on the enemy's communications and billets; there have also been many air combats.

North of the Somme, on the French front, on the evening of the 30/31st, there was violent fighting around the Monacu Farm and in the Bois de Hem, which continued throughout the day: all the enemy's attacks failed, with heavy losses to themselves, and the French held their ground on the conquered positions.

RUSSIAN FRONT.—The Russians are now well over the Stokhod river and are following up the columns of the enemy re-

treating towards Kovel, whilst fighting rear-guard actions.

Since Brody, further South, was taken, the Russians have advanced some 10 to 15 miles, and the flank of the Austrian army on the Sereth river East of Lemberg is now threatened.

GERMAN EAST AFRICA.—Dodoma on the German central railway has now been occupied by General Van Deventer's force; this place being the first that has been taken on the line of railway running from the sea to Lake Tanganyika.

ARABIA.—The Grand Sherif of Mecca has taken Yamba the port of Medina, where the Turkish garrison still holds out.

AIRCRAFT.—The F.M. C.-in-C. reports that an attack by a number of hostile airships developed before midnight on 31/1st Aug.: the raiders crossing our coast line along the Eastern and South Eastern counties including Lincoln, Norfolk, Suffolk, Cambridge, Essex, and Kent.

Correction.

Major J. H. Leslie has discovered a mistake in the Record of General Borgard's services, which I reproduced in the paper on Col. Watson, p. 98, note 2. According to the Record, Borgard's rank as "Colonel of Artillery" was "renewed" by a Warrant dated 1 Ap. 1722. This is incorrect, for in this Warrant (of which I have seen a certified copy) Borgard is appointed Colonel of the Royal Regiment of Artillery.

H. W. L. Hime, Lieut.-Col.

PRÉCIS OF

MEMORIAL DE ARTILLERIA.

(January—July, 1916).

By Major R. H. R. Benson, R.A.

January, 1916.

A Cavalry sketching-board.

Description and photographs, etc. of a suggested design of sketching board for cavalry. The apparatus consists of a box without a bottom, the sides suitably shaped to enable the box to sit steadily on the great-coat, which is carried rolled on the front of the saddle, and to which the box is strapped. In the box are two rollers for the drawing paper which is rolled on one roller led through slit in the lid, across the lid, through another slit and attached to the second roller. A metal rim covers the edges of the paper and prevents the wind from catching it. A pedometer, prismatic compass and double jointed ruler are attached to the box. The designer claims that with this sketching board it is not necessary to dismount and that an accurate road map can be completed in the saddle.

Notes on Ranging a Field Battery.

Obtaining the "zero bracket": (the zero bracket is attained when a group of not less than 6 rounds fired with the same elevation gives an equal number of 'overs' and 'shorts'.) Discusses the probabilities of the range having been correctly found in each of the various cases in which two salvoes (8 rounds) show 3 + and 3− with two rounds not observed or show 4 + and 4 −.

Coast defence range finders.

A general article on the different types in common use, with tables of probable errors; and some remarks on "the error of the day" correction, and 'predicted firing'.

Artillery in the present war.

An article pointing out how essentially preponderating a part artillery has played in the various campaigns of the present war, especially in the German conquest of Serbia.

Notes on the Artillery practice camp, 1915. With map. This year series were fired for the first time with observation entirely carried out by aeroplanes and captive balloons.

Description of Huberts "ballistic balance" for investigating acceleration of the projectile in the bore of a gun, pressure curves, recoil of the gun, striking energy of the projectile, etc.

February, 1916.

The production of War Materiel in Spain.

A Lecture delivered at the Madrid Athenæum, by General Cubillo.

The lecturer opens with some remarks on the enormous consumption of Munitions in the present war, quoting a few striking figures, e.g. that one of the Allies has reached a daily output of some 200,000 shell; the propellant charges for these require some 140 tons of smokeless powder per day: that it is estimated that the daily production of small arm ammunition by the whole of the belligerent powers (including their purchase from neutrals) must amount to some 60 million rounds per day, for which about 150 tons of propellant are required daily.

He points out that the main difficulty in connection with organising such an enormous output lies in the training of the necessary workers, especially foremen, overlookers and senior grades, and not in the provision of raw materials nor in the adaptation of factories or machinery. He goes on to review the position in Spain in regard to the production of war material, dealing with the history and gradual development of the industry, and shows that to-day practically all the material required by an army in the field can be produced in the country, though probably not in the required quantities.

Field Batteries: Time shrapnel fire, all guns having the same elevation. Discusses the probable dispersion etc., and concludes that for a given elevation (medium ranges) when the range and height of burst have been correctly determined, any target within − 25 and + 50 yards of the mean Point of Impact will be effectively covered.

March, 1916.

Height of burst with Time Shrapnel.

A theoretical discussion of the percentage of 'bursts on graze' which may be expected at different ranges for various mean heights of burst.

An appreciation of the French Field Artillery.

An enthusiastic eulogy of the French genius for artillery as shown by the clear insight and sound reasoning which led the French in 1897 to pass at one step from their old 90 mm. equipment to the 75 mm. Q.F. which, with merely minor modifications, remains to-day the best Field Artillery equipment in existence. Shows how the French have been pioneers in all changes in Field Artillery materiel and tactics, and how all other nations have followed their lead.

An article on the equilibrium of aeroplanes.

Mathematical consideration of the forces acting on an aeroplane in flight, and consideration of the question of automatic stability and of flight in a straight line at various velocities.

April, 1916.

The production of War Materiel in Spain.

Continuation of a lecture given in the Madrid Athenæum. The Government powder factory at Murcia; gunpowders and fuze powders: the factory at Granada, smokeless powders (nitro-cellulose) and guncotton: various private firms mostly dedicated to dynamite and various blasting powders. The Toledo factory for swords, bayonets, lances, etc. The small arm ammunition factory at Seville, where fuzes and cartridges cases for Field guns are also made. Notes on the resources of Spain in raw materials; abundant supplies of copper and lead, zinc and antimony: slight deposits of tin, but these are not worked in peace time. For cotton and aluminium Spain would be entirely dependant on foreign supplies.

Heavy Artillery in the Field.

A lecture given at the Staff College, Madrid. Traces the gradual growth of the Heavy Artillery in European armies, from the first adoption of a light Field Howitzer by Russia in 1886 down to the 21 and 28 cm. Howitzers with which the German Army was equipped when the present war broke out. Gives a brief account of the Heavy Artillery equipment of European armies in 1914 at the outbreak of hostilities, and discusses the effect of the introduction of Heavy Field Artillery on Tactics and on Field Fortifications. Then discusses the question of provision of Heavy Artillery for the Spanish army, which is at present without any of modern type. The provision of 4·8 inch Krupp guns and 6-inch Schneider Howitzers is in hand.

Industrial Chemistry in War.

Notes on the application of Chemistry to the various processes in use for production of steel and of the various materials required in steel manufacture, and a review of the possibility of producing these various materials in Spain in the event of foreign supplies being cut off.

May, 1916.

The problem of Munition Supply.

Importance of unfailing and regular supply of munitions, and need for organising the supply in advance arising from the impossibility of improvising on a large scale. Extraordinary consumption of ammunition in the present war; the Germans are said to have expended over 5 million rounds in the first week of the Battle of Verdun. If these had all been 77 mm. rounds the weight would have been 45,000 tons. Remarks on the chain of supply in the Field, and importance of keeping the first line wagons always filled up. Notes on the organisation of the British Ministry of Munitions. Germany's effort: Krupps staff increased from 87,000 to 242,000. Lessons for Spain to learn from the experience of other nations in the present war. Supreme importance of developing

home industries so as to make the country self sufficing in time of war when importation of raw materials or finished products may be impossible. A suggestion that in future men called up for service should not spend the whole of their time in the Army, but that conscripts belonging to any skilled calling which enters into the production of Arms or munitions should after a short period of service in the ranks, sufficient to inculcate a little discipline, be posted to Government Arsenals for a course of training in munition work.

Iron and coal in peace and war.

Modern warfare impossible without supplies of both, and the nation that lacks either or both cannot fight. Unsatisfactory state of the Iron industry in Spain. The country is rich in iron ores, but does not manufacture iron—merely exports the ores: has useful coal deposits, but they are undeveloped. Enormous requirements of Iron ores by all belligerents in time of war: present demands from England, France and Italy: enormous imports from U.S.A. and consequent rise in price. Resources of the Central powers. In 1913 Germany produced about 300 million tons of coal and some 34 million tons of iron and steel. She is now in possession of most of the iron and coal districts of France and Belgium, and the Central Powers can, it is estimated, easily turn out 40 million tons of iron and steel per annum. Spain would take about two centuries to produce the same quantity. Statistics of expenditure of gun ammunition in the present war. It appears that the artillery fires roughly one round per day for every man in the army. The weight of ammunition required for the artillery daily is approximately 4 times as great as the weight of the whole of the provisions (food and forage) for the army.

Notes on modern propellants: chemical and structural formulæ etc. Notes on the propellants used by various nations.

June, 1916.

The production of War Materiel in Spain.

A century ago England dominated all the markets of the world and no other country could compete with her in any industry in which she was interested. This awoke in all other nations a desire to emancipate themselves industrially, which they set about doing by protecting their young industries against foreign competition, with excellent results for themselves as shown by the growth of, for example, the production of steel. At the beginning of the 19th Century the worlds production amounted to 800,000 tons, nearly all English: in 1865 England produced 5 million tons, France 990,000, Germany 880,000, and the U.S.A. 1,300,000. In 1910 the figures were U.S.A. 27,000,000, Germany 14,790,000, England 10,220,000, France 4,030,000, tons. This protection has been applied very vigorously to all war material, so much so that in U.S.A. the Army and Navy Secretaries are not allowed to purchase *any* war material outside the country without a special authorisation from Congress.

Progress of Italy in home manufacture of war material of all kinds. Points out how little Spain has done towards establishing any factories capable of producing the heavy steel work required for modern guns and ironclads. But what has been done in the U.S.A., in Italy and in Japan can be done in Spain. Discusses the initial cost of the necessary establishments, and the advantages which would accrue from their construction.

Description, with diagrams, of a Battery Commanders Slide rule.

Suggested targets for coast defence practice and for Field Artillery. The former is a scale model of a battleship, $\frac{1}{4}$ or $\frac{1}{5}$ full size, built up of tubular floats with a light framework superstructure covered with canvas. The latter take the form of 'dummies' which are laid out on the ground and are made to stand up by means of a counter-weight released by means of a quick match or electrical gear, and are in the same way made to disappear after a short interval of 5 or 7 minutes.

July, 1916.

Coast defence range-finders.

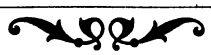
A description of the two patterns in use in Spain, depression instruments, and of various accessories—e.g. plotters—used with them, and remarks on their use, limits of accuracy, etc.

Copper and zinc in peace and war.

A popular article dealing mainly with copper, from the time of the Phœnicians, and its various uses alone or alloyed. The worlds production in 1914 and 1915, showing that the U.S.A. produce more than half the worlds total output, and that the next biggest producers are Japan, Chili and Canada. The enormous consumption of copper in the manufacture of munitions.

Some notes on the effects of shrapnel fire on various targets—mainly theoretical calculations of probable hits, given accurately corrected fire.

A short note on the Battle of Jutland, the lesson which the battle teaches (so far as one can judge from the published accounts of the battle) is summed up in the phrase, "Speed is not a weapon; the gun is." The writer considers that the tendency to sacrifice protection (and, to a less extent, gun power) to speed has been overdone, and maintains that it is the heavy gun in the heavily armoured ship that decides matters in a modern Naval Battle, irrespective of speed.



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